# AESS MEETINGS & CONFERENCES

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Iram J. Weinstien, Associate Vice President-Conferences

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Send all corrections and omissions to Barry C. Breen at his address on the inside back cover.
This Month’s Cover...

Ken Broyles of Malibu Research was photographed with a California condor as he pleaded: “Please, do not use the coasts from this tower for your nest…”

To our readers: Do you have a photograph that you would like considered for use on a future cover of Systems?

If so, send it—both printed and on disk—to the Administrative Editor at the address on cover 3.

Correspondence

Editor:
For a time in the late 1970s, I had the privilege to be the systems engineer for the Large Amplitude Multimode Airborne Research Simulator (LAMARS). From this perspective I read “Fly-By-Wire & T&E Challenge” in the February issue of Systems with a mix of nostalgia and pride. I reflected on long ago debates that questioned the need for motion-based simulations and the future of motion-based simulators and appraised the continued and future contributions being made by motion-based simulators like LAMARS.

Evelyn Hirt
e.hirt@ieee.org

Editor:
I just received Pelka’s fine book review of Signal Chase (March). I found myself delighted that you could not tell how the story would end until the last chapter. Your criticism was very much on target, and I liked your candid observations about the characters and technology issues.

Your remarks about writing assignments, such as at November, reminded me of my conflicts with well-intentioned English teachers in high school and university. I had such a flaccid and sore on my soul over a paper on Richard III. If you cannot, or will not, engage in their self-appointed neurolizing ramblings, the literature experts cut you down and dismiss you as an intellectual imbecile to be consigned to the drafting table. That might have made a better feedback loop than the mathematics class teacher ever could.

Thanks for a good and fair review. Perhaps you will soon become a literary critic in your retirement.

Jim Taylor
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In This Issue - Technically

Pick Any System: What is the Real Cost?
The realities of a system’s development process are described by the cliche: “Pay me now or pay me later.” Everything costs something — there is no free lunch. However, there are less costly lunches. We are driven to lessen the cost, while still trying to garner the same or greater value. All decisions have a relative cost associated with them, in both the short- and long-term. Further, this cost is seen differently by those who pay it, than by those who make the decisions that incur it — they are often not the same people. Yet it should always be our charge to manage the reduction of those costs over the life cycle, not just under our watch.

The Flying Object: A Flight Data Management Concept
The drive for greater cost-effectiveness and improved safety/security in an environment of increasing air movements calls for improved availability of accurate and consistent flight data to stakeholder systems. Studies conducted by EUROCONTROL in 2001-2003 indicate significant levels of inconsistency between flight data available to Aircraft Operators, Air Traffic Control (ATC), Air Traffic Flow Management (ATFM), Airports and Military systems, causing unnecessary workload, inefficient use of resources, and unnecessary delays.

Eurocontrol’s new Flight Data Interoperability Concept is intended to resolve this problem. Having passed through the initial feasibility phase, this concept is now entering the development phase, in which it will become the basis for the development of a draft interoperability standard to be used in Europe for the specifications of new flight data processing systems deployed from 2007 onwards, and potentially to be proposed to the International Civil Aviation Organisation (ICAO) for global standardisation.

Are Inkless Fingerprint Sensors Suitable for Mobile Use?
This paper presents an evaluation of the main differences between fingerprints obtained from a low cost inkless sensor and from the classical ink-and-roll fingerprint images used in police applications. Our experiments reveal that although the image size and quality are quite different, it is possible to introduce the inkless fingerprint into the police database and to obtain a correct identification. This shows there is room for proposing a remote fingerprint identification from a police car, using the GSM mobile telephone network.

Microsatellite Combined Attitude/Energy Systems
We have constructed a high-temperature superconductor-magnet momentum wheel for microsatellites and propose a micro high-temperature superconductor energy storage and attitude control system for nano/pico satellites. The momentum wheel for micro satellites has a mass of 1.1 kg with an angular momentum capacity of 3.5 J sec. It occupies a volume of 12.7 cm in diameter and 5 cm in height. It operates within the restricted power budget of a microsatellite with a total power supply of only 10 watts. It consumes less than 1 watt for sustenance.

The micro high-temperature superconductor flywheel for nano/pico satellites has an angular momentum capacity of 0.083 Js and stores 2.32 kJ at 530 krpm. Its energy storage capacity is approximately 45 Wh/kg with an energy density of around 370 kJ/L.

The HTS systems can perform the dual function of a power/attitude control system and are ideally suited for low earth orbit energy storage, power generation, and attitude control of spacecraft.

Curbing Gambling Activities on the Internet
Gambling is prohibited in Taiwan, although it has existed in the society for a long time. With the emergence of the Internet in the past decade, not only is E-commerce being promoted, but Internet gambling as well. The negative influence of Internet gambling, however, is much greater than the impact of traditional gambling on our society. Due to the properties of anonymity, lack of boundaries, and the rapid spread on the Internet, it is becoming increasingly difficult for law enforcement to seize suspects who engage in illegal gambling. In this paper, we introduce some serious problems resulting from Internet gambling, and provide a procedure to investigate and curb the spread of Internet betting in Taiwan. According to our proposal, the information of evidence collected is believed to be presented conclusively in a court of law. Persons attempting to bet on the Internet should be deterred.

Differential GPS Dynamic Location Experiments at Sea
Differential GPS on board naval vessels has been tested in severe multipath archipelago environment against a commercial laser tracker system. The average location difference was 3 meters and two periodic error components were found. Their time constants were 1.8 and 28 seconds and the peak amplitudes 1.5 and 1.1 meters, respectively. In addition to these, a clear dependency of location error standard deviation figures on the GPS antenna mounting distance from the sea level was observed.
Pick Any System:  
What is the Real Cost?

Karl A. Voigt  
US Navy

ABSTRACT

The realities of a system's development process are described by the cliche: "Pay me now or pay me later." Everything costs something — there is no free lunch. However, there are less costly lunches. We are driven to lessen the cost, while still trying to garner the same or greater value. All decisions have a relative cost associated with them, in both the short- and long-term. Further, this cost is seen differently by those who pay it, than by those who make the decisions that incur it — they are often not the same people. Yet it should always be our charge to manage the reduction of those costs over the life cycle, not just under our watch.

INTRODUCTION

Pay me now, or pay me later:  
"Pay me now, or pay me later" — a cliche? — Yes! Is it still appropriate to our time? Most certainly! However, I propose that it is more appropriate as, "Pay me now, or pay me more later." Cost is an undesirable, yet necessary situation in the arena of a Test Program Set development and production. Everything costs something. It is an inescapable fact of the real world — there is no free lunch. However, in theory, at least, there are less costly (or more cost-effective) lunches than others. We are forever trying to lessen the cost we pay for something while still trying to garner the same or greater value. All decisions have a relative cost consequence associated with them, both in the short- and long-term. Furthermore, this cost is seen differently by those who pay, than by those who merely make the decisions affecting cost, though it should not be, but it so often is — it's a leadership ownership thing. The decisions we make today are the decisions our successors must shoulder and live with tomorrow. We combat this by trying to impose a "systems" and/or "life cycle" view and attempt to exercise informed disciplines of managing the "life cycle" of a system.

Does Cost Always mean Dollars?  
We seem to have a national obsession to boil cost down to mere dollars. We equate nearly everything to this fiscal metric. However, inasmuch as dollars are a valid and meaningful measure, there are "costs" that are not so easily or meaningfully quantified by dollars, but they are "costs" nonetheless. The articulation of all costs to merely a dollar figure, does not necessarily capture the true significance or value of these costs, such as in the loss of life or in the context of Operational Readiness. Furthermore, the timeliness of capturing costs is a significant challenge as well. Tomorrow's cost of our TPS development decision today is borne by those who inherit the TPS Project or deliverable in the future. It should always be our charge to manage the reduction of those costs over the life cycle — not just those under our watch. But, you say, we do "preach" this theme. And in some arenas, we try to, and quite successfully, accommodate this thinking. True, however, in many others we do not. The focus of this discussion, specifically, is that we, by the way we organize ourselves, do not in practice, promote managing to the life cycle. We regularly and regulatory measure the short-term things and do not hold the long-term metrics with the same interest, intensity, or scrutiny. Thusly, we tend to get what we measure. The sound bite shared with young Army leaders in training, "Expect what you inspect..." is invariably true. A news article by Giles Whittell — reprinted on next page [1], from a few years ago describes that 144 lives were lost for the sake of 197 pounds of silver illustrates, quite tragically, what happens when you measure or value the wrong goal.

PLANNING FOR THE LIFE CYCLE

With the end in mind  
"... If you aren't sure where you want to go, then it doesn't matter which way you go."

The ever-tinkling Cheshire Cat in Disney's adaptation of Lewis Carroll's Alice's Adventures in Wonderland.  
It continually amazes me that contained in children's entertainment and literature is the wisdom the ages. In this
144 air passengers died to save £197

FROM GILES WHITTELL IN MOSCOW — A RUSSIAN airliner that crashed in Siberia killing all 144 people on board may have done so because its pilots were afraid of having their pay cut for wasting fuel. No official cause has been given for the loss of a Vladivostok-based jet that went down near Irkutsk last month, but a report based on a reconstruction of the disaster by Russian crash investigators has concluded that the pilots lost control of the aircraft while trying to avoid a gradual descent that would have burnt an extra 500kg of fuel. The Tupolev 154, a three engined jet used for half of all civilian flights within Russia, was approaching Irkutsk on July 4 en route from Yekaterinburg to Vladivostok when it vanished from air traffic controllers’ screens and plunged to the ground from an altitude of nearly 3,000 ft. It began its final approach traveling too high and too fast, according to Ogonyok, news weekly that obtained a copy of the investigators’ preliminary findings. “Normally, in the interests of safety, the pilots would perform a second circuit (to lose height),” the magazine’s aviation correspondent writes, “but these ones decided against a second circuit.” The report, headlined “A Tu-154 crashed for $280 (£197),” goes on to claim that the pilots stood to have that amount docked from their pay for flying a second circuit if it was found to be a result of their earlier error in judging their final approach. Officials were swift to blame pilot error because the aircraft’s landing gear and flaps had been properly deployed. Its auto-pilot appears to have pulled its nose up as an automatic response to the pilots’ rapid braking. The jet then appears to have stalled, banked to port and gone into a spin.

case, that of planning and thinking through the End State of a goal — as Lewis Carroll includes in Alice’s adventure [2].

Stephen Covey’s, The Seven Habits of Highly Effective People, [3] has lent a significant impact to understanding how we can face personal and professional challenges in leadership. Although Covey’s approach is to start discussing this habit with a personal view of our ultimate end — our death, the ideal of viewing the End State before you begin is priceless counsel. Covey explains this habit in the context of all things are created twice — first the mental creation, then the physical. Many describe the mental piece as having a dream . . . and many still have been attributed with having the vision to dream and then the drive to create the physical reality that matches that dream. Regardless of how you term it, Covey’s message is simply the mental creation of our end state (the intended goal of our plan) is essential to all that we do.

Covey goes on to explain this thinking by using the age-old dilemma of Leadership vs. Management. The first creation is a leadership task. And the physical creation is the management task. He illustrates the contrasts between management vs. leadership skills in the roles of a jungle clearing analogy. In his analogy, and ignoring the undesirable environmental issues, he assigns the roles of managers, and producers to those doing the actual tree and brush clearing. They are the ones doing the cutting of trees, the development of machetes, saws, and shovels to most effectively and efficiently bring the trees and brush down to clear it away. This is in contrast to the leader who, in the continuation of Covey’s analogy, climbs to the top of the tallest tree, surveys the entire situation and assesses that something is wrong . . . and finally yells, “Wrong jungle!”

The responses of the managers, who find this revelation tiresome, counter with, “Shut up, we’re making great progress!”

Humorous? Yes. But why? I suggest we find humor in this because it is ridiculous to pursue something just because we are
doing it well when it is, in fact, the wrong thing to pursue. Further, I pose that we see this in our daily reality. While it is good to be able to laugh at ourselves; on some level, Is not this something to be somewhat embarrassed about? Or, at least, to motivate us to stop clearing the wrong jungle and redirect our efforts to the right jungle? A leadership definition of insanity can be to expect a different result from continuing to do the same things we have always done. The sound bite that captures this ideal is, “If you keep doing what you always did, you will always get what always got.”

Life Cycle Cost Modeling and the Opportunity
What a program is destined to actually cost, over its life cycle, is defined, primarily, by the decisions made in its early phases. Paradoxically, when the least amount of firm, detailed design is defined, is when we make the greatest impact on those costs. Said another way, the most significant impact on Life Cycle Costs or (LCC) is achieved before Milestone A (analogous to the old Milestone I — see figure 1 to view a comparison of the old program template contrasted to the more recent DoD Guidance).

Major system decisions made in the earlier phases have direct and far-reaching second, third, and even, fourth tier impacts on the system’s design later in the program life cycle. Such decisions “lock in” or commit a program to major costs based on the nature of the redirection. It follows that the opportunity to significantly influence LCC diminishes as the program matures. Figure 2 visually depicts this idea. The lower line portrays, notionally, the actual program expenditure over time and the upper line depicts the LCC fixed or committed to over time. As a general rule of thumb, by the time about 15% of the LCC is actually expended, about 85% of the total LCC is already predetermined by the decisions made to that date — this is roughly at Milestone B or II. This is not to say the LCC is even really known or quantitatively or reliably predictable at that point. However, the things that affect LCC are decided upon by then — thusly, courses of action and approaches are committed.

Systems Thinking / or View
This notion of systems thinking has been latched on to by many advocates in the last 10-15 years, but in 1990 Peter Senge, published his book, The Fifth Discipline [7] which was not a systems thinking book, as such. He did have a lot to say about systems thinking, though. To capture his message about the Learning Organization you need to understand and embrace his Systems Thinking definition. To be players in his Learning Organization you need to be able to view things as systems. Having said that, Senge does offer up a very simple definition of “Systems Thinking” as a discipline for seeing wholes [6] (vice holes). Though, it is not a simple practice, at least at first, as it requires some paradigms and mental models to be shed by its proponents. It ends up that this becomes our biggest barrier — our own mental models and biases. Just as Walt Kelly’s comic strip character, Pogo is reputed to have once said, “I have seen the enemy and it is us.”

![Fig. 2. Cost Model – Life Cycle Commitment Model [5]](image)

To embellish further, Systems Thinking is a framework for seeing relationships, intra- and inter-relationships rather than just fixed things — for seeing patterns of change and dynamic influences rather than static “snapshots.” It sees not just what is, but what can be — a discipline that teaches how to see the whole. Systems thinking and its associated language expresses ideas and concepts that views structures multi-dimensionally rather than linearly (only 2-dimensionally). Senge describes and teaches it more as a problem solving methodology but I pose it as an entire outlook or philosophy. A “holistic” understanding of the systems we operate in and interact with. An understanding of which is essential to affect them. Systems Thinking is not today’s Management Buzz-word-of-the-Day but a true mental discipline that inhibits resignation to the concept of, “. . . there’s nothing I can do, it’s the system.” As the theory goes, by seeing these “relationships” and “wholes” you can see and understand how to affect them and, thus, you shed these ties that seem to hold us back.

IT’S NOT A BUZZ-WORD BUT A MIND SET

“The world we have made as a result of the level of thinking we have done thus far creates problems that we cannot solve at the same level (of consciousness) at which we have created them . . . We shall require a substantially new manner of thinking if humankind is to survive.”

Albert Einstein

Why Do We Resort To The Short View?
As much as we try not to, we end up defaulting or resorting to managing in the short-term. We are the product of the philosophy of breaking a large effort down into components — following the old adage, often referred to as “White’s Law,” which states “The best way to eat an elephant is one bite at a time.” The theory being that these “bite-sized” elements are then individually manageable — not a bad approach except when these bites are then managed independently, without regard to the other bites. The supporting assumption is that the
Fig. 3. Senge’s Shower System Temperature Model

The system is merely the sum of its parts. We have done this technique for so long, that we now practice approaching the managing of our programs (especially our larger ones within the DoD, at least) by defining a need — as an operational requirement. Then we assign a solution and this becomes a program such as the Joint Strike Fighter (JSF). We begin executing this program over the course of its 20 plus year life. Then we end up breaking it down to monitor it through fiscal plans with six-year budget views and projections. We budget for it using a 2-year POM cycle. We staff it with 1½ to 2 year tours for essential decision-makers. Then we finance it with 1 year funding that is 1-3 months late arriving to the user. And these funds are further reduced by some 8 to 25% because . . . you know . . . you will not need that level of funding because of the abbreviated year — having received the money late and all.

And this is done without regard to the impact to the preceding or succeeding year — but you know we are saving money . . . We have institutionalized this to the point of really thinking that we make a difference — can you say A-12? All kidding aside, I must say we are making a difference. Just like the pilots of that Tu-154 saved £197, we are making the same differences as we continually fail to see things in terms of the ultimate or eventual impact or cost — a cost we end up paying — whether we can afford it or not.

Having said all this, Is this what we want to do? Of course not. So, if this is not where we want to do or go, Why do we end up there so often?

So, what is the problem?

Let us examine Peter Senge’s simple shower example in his 1990 book, The Fifth Discipline [7]. Imagine if you will, that you wish to shower using a shower of an older design, often found in older homes and hotels. The design is simply two water valves – one for hot and the other cold. You turn on both with the idea that you want warm (an ideal mix of hot and cold) and you get cold water. So, you wait a good second or two but it is still cold. Then you figure that you will just turn on the hot more, figuring you’re going to move this along, because, you know... you don’t have all day. A few more moments pass and you find that you now have scalding hot water coming out of the faucet. So you either turn the cold up, or more likely, you turn the hot down . . . a lot. There, that should do it. You fixed it. So, moments later you test it again and now it is frigid. What gives here? You start to get frustrated – so you turn the hot on again . . . and it is seconds (seconds that seem an eternity) before you feel a change so you turn it up again . . . more and again, more. Now the water is scalding – again. Your frustration builds as second-degree burns are not normally on your daily hygiene plans.

Now, this simple “system” operates with a time lag. The ultimate result happens long after the stimulus is affected or inputted into the system. Senge models this system in Figure 3. Applying Covey’s lingo to Senge’s model, the Desired Temperature is the end we have in mind.

Now, if you merely waited or have been more patient to see the results of your input, you might have been more pleased with the ultimate result. I contend that the state of the management practice of many of our systems manages using a similar model. That is to say, the, “Brute Force and the Ruthless Expectation of an Immediate Result” model. We exercise a change (sometimes an extreme change) in stimuli and when we do not see the desired result immediately, we change the stimulus again and again (either the same one or another). Our thinking trends toward, “No result when I want it, hmmm... that means, obviously, I must not be managing it enough.” But when the stimulus actually begins to show up in the output, it is not what we wanted – Go figure! It has too much correction or the wrong correction. We do not seem to notice this from the proverbial step back (even if we take that infamous step back), and our impatience takes over. We need an answer – a result – now! When we do not get it, we must not have done enough or the right thing so we do something more. We have to tinker with it – we need to manage it some more.
Otherwise, we have failed in some way—we are, obviously, not up to the task. Someone who is up to the task, thus, must replace us.

Now, How often is this played out in Corporate America or in the trenches of our various field operations—either in reality or in our imagination? When you do your job right, you may not see a real result of your work for three or more years but you need to show a result or an impact in one year—or sooner—by the end of this fiscal quarter, say. So, what do you do? MIT’s Sloan School of Management’s Beer Game, also described in Senge’s 5th Discipline, illustrates this dynamic [8]. I will not examine the Beer Game here, but assert that, in observing the Beer Game dynamics, we see how easy it seems to become a prisoner of the system and become unable, seemingly, to get to the desired result—no matter how hard we try.

Our Mental Models of Management and Leadership Jobs

Now, let us reflect on the leaders of a project, key decision-makers in the program organization. They are often in position for only 12 to 18 months or so—sometimes less. And to get “credit” for this job he/she needs to serve, say, only 12 to 18 months. Further, in 12 months they need to do something that leaves their mark. Even if it does not serve the mission, it serves their goals of getting credit for doing a good job and making that difference... (Don’t get me wrong, wanting to do a good job is not the bad thing here, my concern is we are more impressed by the fact that we get credit for the things we do in “jobs,” irrespective of how related to the mission they are). After which, they are off to the next job they will only need to spend 12 to 18 months in. They do this because that is what they are rewarded for... It portrays them as having a diverse experience base. This is seen as good—at least, it is rarely viewed as “...not having served in a job long enough to make a true difference...” or even learn and know the job for that matter. We do this in the uniformed services because we want well-rounded Soldiers, Sailors, Marines, and Airmen with diverse experience bases. But this is OK, because stability in the program work-force comes from the civilian force. Well, I contend that logic is a fool’s folly, as it is not based on contemporary reality. Though there are exceptions, moving around, as I describe has evolved to include civilians wandering down this path in civil service, and in the private sector. We do this because, we want “well-rounded” civilian leadership with diverse experience, too. And yet they, too, have to make their mark, and so they do... and we call it good. We promote this practice and we promote because of this practice. It is a chicken or the egg argument regarding which feeds which. However, regardless of which promotes what, we find ourselves having evolved, organizationally, at least, to encourage what one senior Army officer I know refers to as “Badge-Finders.” He uses this term to refer to those who seek merely the “badge” so they can sport it on their chest (and/or resumes) rather than focusing on the mission need or its goals at hand. Many attribute this mindset to the differences in generations (Baby-Boomers vs. Generation X vs. Generation Y, etc.). However, irrespective to the physiology behind it all, what we see manifests in the end state of doing things because we look good having done them, not because the mission required them.

To visualize this concept of potential discord caused by multiple short tours, let us view a representative project. Figure 4 is a Gantt/Milestone chart form of a nondescript program or project Plan of Action and Milestones. Project tasks and milestones, along the timeline of a planned project execution are represented, generically. Now, let us overlay the periods of the various tours of significant decision-makers over that same Gantt chart to see where these decision-makers fall with regard to the overall timeline for the program, we see this in Figure 5.

Now, compound this with the folks he/she must report to and those he/she delegates decision authority down to at every level. This incurs a complicated combination of mismatched timelines that only serve to introduce challenges to project integrity—cohesion is catastrophically threatened—if it even existed at all. Then, introduce an annual rating or FITREP system that focuses on short-range successes (What are you going to accomplish this next year? Or the next few months?) Now, add to the mix a complicated process of fiscal management of one, two, and three year funds that are managed annually or on a shorter cycle. What do we end up with? We end up with a management and leadership system that preaches that many complex systems have an actual life cycle approaching 20+ years, but a practiced series of life cycles lasting only as long as assignment tours. So, if a decision-maker defers an investment now, or changes the direction of the program, he may, in fact, avoid costs now under his/her watch. However, if the goal is to reduce costs in his/her tour, then invariably this commits the successor(s) to shoulder potential future costs that were unplanned and likely not resourced. This change in scope usually and ultimately results in higher costs to be paid later. And the best part is, these expensive decisions, once made, are not attributable to that decision-maker, but must still be borne by the program leadership that follows. Thusly, he/she is not necessarily motivated by this concept to manage to the true life cycle, only within his/her tour.

Things get more complicated when you view the Six-Year Development Planning windows, which are overlaid on our same representative project in Figure 6. At each cycle,
decisions are rendered that may or may not have any relationship with the previous or succeeding cycles. And as much as it would make sense to retain consistency from one development plan to another, there is often not. At each succeeding planning cycle, we have a new set or combination of decision-makers, motivations, and agendas. You can easily see that the results are often confusing, and conflicting in direction — imbedded with delays, cost increases, and over-runs, not to mention technical challenges. These challenges are accentuated when envelope-stretching technology is involved — such as in the F22, JSF, and F/A-18E/F developments. So, how is this managing to the Life Cycle? All are significant programs of the scale that span 5-10 years from concept to actual introduction of production and deployment, not to mention their respective 15-25+ year operations and maintenance phases.

This revelation is not news but is not always very popular. The idea of not looking at the long-term consequences of our actions was articulated (though controversially) using the available money needed to invest in strategic modernization and growth. The Honorable Dr. Jacques Gansler, Undersecretary of Defense (Acquisition & Technology) in the late 1990s described this phenomenon as a vicious circle that has been termed as the much-chid "Gansler Death Spiral" [9]. See Figure 7.

The same analogy applies to costs incurred by decision-makers deciding on design and program direction and operations. It, too, is a vicious circle. Gansler's Death Spiral is a model for the state of practice, and I further point out, that, at each juncture labeled in Figure 7, compounds my point when you introduce a different set of Key Decision Makers making decisions to defer investing in Strategic Modernization, increasing OPTEMPO, etc. It changes the dynamic of the flow drastically — usually negatively.

**OK, HAVING SAID THAT, WHAT TO DO ABOUT IT?**

Just as Alice, to get back home, had to remain focused on her goal of getting home amongst all the distractions of the Tea Parties, un-Birthdays, rose painting, and the tyrannically unbalanced agenda of the Queen of Hearts, we need to view a program in the context of its intended end state. It is interesting to note that many programs face, as Alice did, a world of random distractions similarly unrelated to the goals of the program. Each of these distractions, seemingly, geared to prevent us from realizing our goal. We, like Alice, need to keep focused, "... on what it is we are trying to do." So... What is it that we are trying to do?

**Leadership Views and Perspectives**

In a February 2002 interview with Jim Lehere [10], Defense Secretary Donald Rumsfeld posed a revelation that changes the thinking of how we devise our defense posture in which he poses a capabilities-based defensive posture versus a threat-based posture. Rumsfeld states, "It means that instead of deciding you’re going to look at a threat in North Korea or a threat in Iraq or a threat somewhere else (like) the old Soviet Union, and fashion your force to fit that, what you do is look at the capabilities that exist in the world — chemical, biological, nuclear capabilities, cyber attacks, that type of thing. And you say to yourself, it’s not possible to know precisely where the threat will come from or when, but you can know what nature that threat might be and what capabilities we need to deal with that." He continues, "... is not an event, it’s a process. It involves a mind set, an attitude, a culture." He introduces a very radical but simple change in view which affects the way we structure this end in our mind.

*Change the way we think?* — hmm, easier said than done — for sure but essential. Now, he was talking about the act of Transformation itself but the ideals apply, for they extend ideally to the cost reduction acts, as the systems thinking philosophy affects nearly all aspects of how we lead, operate, and manage ourselves.

Now, to further understand this view, let me define a few more ideas, Strategic and Tactical leadership. Mostly thought of in military terms, yes, but the concepts are applicable across many arenas.
Strategic Leadership

Strategic leadership is leadership and thinking on a very large-scale - it is the consummate systems view. That is to say, in military terms, the idea of strategic leadership is akin to the operations in a theater such as the European or Pacific Theaters in World War II [11]. Strategic leaders think on a very large-scale in terms of multiple time domains, regions, and resources of an economic sector of the world. Strategic leaders see the “big picture.” In our TPS world, a program may be to develop and deliver a Test Program Set to support a specific platform, system, or group of systems. The strategic TPS developer sees TPS development on the larger scale. He/she sees how the TPS development meets the contract requirements but fits into the overall test philosophy and test architecture of the Navy. As an example, he/she leads the effort to integrate the TPS development to be a part of the whole strategy of migrating to the CASS’s support architecture, which has been the Navy’s charge for over 15 years now. To carry the analogy further, the strategic leader leads on a large scale affecting those things that affect multiple TPS developments as well as impacts to entire systems and related systems such as the Navy testing philosophy or even its whole maintenance philosophy. The system’s view of a strategic leader’s vision sees things on a holistic level. The strategic leader has a future focus - he/she sees things in the long term. Strategic thinking captures the complex sets of systems that operate over extended periods. He/she recognizes the interfaces with other Navy support systems such as the supply or training systems not just the hardware and software of the various TPSs in question. The strategic leader understands these and understands why the tactical leader’s contract requirements are the way they are... Strategic thinking recognizes and understands the life cycle truly from the birth to retirement/disposal.

Tactical Leadership

In contrast, Army references cite as Direct, or what I am calling here, a Tactical Leader leads in the here and now [12]. I am using the term tactical to refer to the immediate or nearby situation or area of operation. Militarily, it has other meanings, regarding type of skills and actions. But my use of the word is in the micro, compared to the macro of the strategic. The tactical leader leads these bite-sized elements from the realm of the strategic leader. The tactical leader leads the TPS delivery to meet the contract requirements. Tactically, he/she may understand how his/her project interfaces with the larger scheme of the USN’s CASS but he/she tends to focus and deal with things on a detailed level. He/she is concerned with the techniques and actual deliverables. He/she is the person that insures the TPS actually works and performs to the contract requirements standard. The systems view of the tactical leader is that of a system of things within the TPS contact – the systems of individual contact management, the data and hardware deliverables, etc. He/She understands the interfaces necessary within the contract boundaries necessary for her to accomplish this mission. And just as importantly, the tactical leader should have a strategic perspective as well understanding how his/her effort fits in the bigger scheme and recognizes when a good course of action for him/her is detrimental to others and to the larger strategy.

Many tend to manage strategy with tactics and not tactics with a strategy. Different as they are, they cannot be separated for they should compliment each other and often do when done right. However, we often tend to engage in discussion of one without recognizing the other or their relationship.

The Archaic Up and Out System

This Badge-finder practice is re-enforced, at least, by the move Up or Out policies that our uniformed personnel policies promote. “Up or Out” is a colloquialism that refers to the practice of if you don’t move up (i.e., get promoted) you need to get out (out of the way); that is to say, separate from service or retire. Essentially, this system is designed to create opportunities for up and coming stars in the ranks... so we do not have dead weight in the higher positions keeping young rising stars from coming up through the organization. Now, this is not as institutionalized a program in civilian sectors as it is in the uniformed arenas, but it is a factor in the short tenures and tours in which we have discussed in this paper. The “Up and Out” policy intends to keep a fresh crop of folks coming up through the ranks. A symptom (or unintended consequence) has been to promote a ritual of only needing 12-18 months in Command or as Program Manager (which nearly equates to Command assignments in uniformed circles). Getting the credential of having served, getting that minimum credit, checking the block, and moving on to the next block-checking assignment becomes the focus and the mission, unto itself. Block-checkers tend to become self-involved and are often seen as marginal leaders because they do not take ownership. They are only there for the benefit to themselves and not the program or to serve the mission. The irony comes from the fact that Block-Checkers are often selected for choice promotions, choice jobs, for more block-checking jobs, and for more lucrative and powerful positions - for the promotions. The good news is, not every one is a block-checker. It is short lived, however, as the checkers tend to the wield influence, as they are picked over the other guys that stayed in a job for more than his required time to make a difference or to follow through with an initiative that he/she started. That noble act or cause is rewarded by having someone else recognized for doing nothing but short-term actions taking short-lived advantages.

Rethinking the Personnel Management Systems

The world is not hopeless, as, at least, some of our leadership has started to recognize this and has begun trying to break away from this vicious circle. Secretary Rumsfeld posed a plan roughly articulated in the 14 April 2003 issue of the New York Times [13] indicating that he has asked, Congress for “broad new powers to reshape the uniformed services from the highest ranking officers down...” A relatively recent and
probably the most overtly publicized proposal by the Secretary contained personnel changes at key decision-maker levels. It provides for longer tenures for the more senior generals and admirals. He asked to raise the retirement age from the current 62 years and allowing a number of four-star positions to serve beyond one term.

Rumsfeld is, quoted in the article, “Even at lower levels of the general and flag officer corps, the goal would be to have more senior military leaders spend more than the traditional two years in a single job.” And he continues, “[The armed services] make a terrible mistake by having so many people skip along the tops of the waves in a job and serve in it 12, 15, 18, 24 months and be gone,” he said. “They spend the first six months saying hello to everybody, the next six months trying to learn the job and the last six months leaving. I like people to be in a job long enough that they make mistakes, see their mistakes, clean up their own mistakes before they go on to make mistakes somewhere else.”

Though, Mr. Rumsfeld’s proposal is not a panacea, it does recognize that the current institutionalized practices of “Up and Out,” as well as, the “staying in a job only long enough to get the credit,” are marginal practices that play havoc with program leadership and operations. Such practices cost in terms of mission effectiveness. Now, I do not cite his plan as a point of support for it but merely that Mr. Rumsfeld’s recognition of these flaws in our state of practice is an essential first step in the affecting of a change (in the DoD, at least). Regardless of its form, change will, admittedly, come hard because it challenges many comfort zones and the way many see themselves as heir apparent to these leadership jobs. However, I pose, simply, that if we are to practice this ideal of mission first, then we must not view programs and decision-maker positions as a jobs programs to get cool badges for technical and professional waifs, but a process by which we accomplish a mission.

CONCLUSION

The systems view, the future view, the long view, the strategic view - all are, as Senge says, a mental discipline - a way of thinking. It is a mission-oriented way of viewing programs and projects. It goes to recognize the mission accomplishment as its goal. It discourages parochialism and fiefdoms and promotes the intent — it is a view that keeps the end in mind.

As we discussed, there is already a move in the current Administration to affect the “State of Practice” of personnel practices in the uniformed services. If implemented, it will affect civilian sectors of DoD, and likely, affect other areas of federal service, too. Of course, recently, it has caused quite a controversy, but the element of his plan that is relevant here, is the elimination of artificial limitations of tenures so key decision-makers are able to stay in key jobs longer without having it be detrimental to their careers. It presupposes that good leaders and decision-makers need to stay in their jobs longer. In effect, the theory is to allow (even encourage) the good and effective leaders to remain in a job, that he/she is doing well, longer allowing them more latitude and ownership of the benefits and consequences of their decisions. This plays havoc with the move up or out proponents, but regardless of whether Rumsfeld’s plan is a good scheme or not, at the very least, it recognizes that our current practices do not support how we should do business and that we need to change our thinking.

As you know, Alice made it home . . . we can, too!

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The Flying Object:  
A Flight Data Management Concept

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ABSTRACT

The drive for greater cost-effectiveness and improved safety/security in an environment of increasing air movements calls for improved availability of accurate and consistent flight data to stakeholder systems. Studies conducted by EUROCONTROL in 2001-2003 indicate significant levels of inconsistency between flight data available to Aircraft Operators, Air Traffic Control (ATC), Air Traffic Flow Management (ATFM), Airports and Military systems, causing unnecessary workload, inefficient use of resources, and unnecessary delays.

Eurocontrol's new Flight Data Interoperability Concept is intended to resolve this problem. Having passed through the initial feasibility phase, this concept is now entering the development phase, in which it will become the basis for the development of a draft interoperability standard to be used in Europe for the specifications of new flight data processing systems deployed from 2007 onwards, and potentially to be proposed to the International Civil Aviation Organisation (ICAO) for global standardisation.

INTRODUCTION

In today's Air Traffic Management (ATM) environment, the data concerning flights available to stakeholder systems is frequently inconsistent. Studies performed by Eurocontrol have shown that in some ATC Centres up to 44% of flight plans have a difference in two-dimensional (2D) routing compared to the plans for the same flights available to ATFM, while up to 63% of operational flight plans used by aircraft operators had differences in flight levels compared to those available to ATFM.

The most frequent specific causes of these problems are:

- Application of Local Agreements affecting coordination points or levels between ATC Centers, unknown to ATFM or aircraft operators.
- Procedures concerning Restricted Areas inconsistently applied.
- Uncertainties about departure and arrival procedures to be applied for certain flights.
- Uncertainties about aircraft performance figures available to ATFM and ATC.
- Uncertainties about application of level restrictions.

Figures 1 and 2, which are taken from Eurocontrol's studies, show examples of inconsistencies in flight data in the lateral and vertical planes, taken from the flight data processing systems of selected stakeholders. In both figures, the "actual" routing is taken from radar reports. In Figure 1, the planned routing as given in the flight plan is quite different from the actual routing, and consequently, the ATFM estimates of sector loading caused by this flight were inaccurate. Figure 2 shows a flight for which the actual climb was very close to the estimate made by the aircraft operator, but quite different from that calculated by ATFM, because a published level constraint in the departure phase was not applied in practice. These are just particular examples of very frequent inconsistencies which occur daily in the whole ATM system.

In summary, the inconsistencies are caused by insufficient interoperability between systems and the lack of a common reference for flight data which can be used by stakeholder systems. The consequence of the flight data inconsistencies is that tactical planning and live operations are often based on inaccurate flight data, causing inefficiencies in the use of capacity and other resources, and sometimes even with a safety implication.

TODAY'S FLIGHT DATA INTEROPERABILITY MECHANISMS

Figure 3 summarizes how flight data for most Instrument Flight Rules, General Air Traffic (IFR GAT) flights is exchanged in Europe today. It is recognised as an
Discrepancies between Actual and Planned 2D Routings

Fig. 1. Example of inconsistent flight data available to ATFM and ATC

oversimplification for some specific cases, but is intended to be sufficient for the purposes of this paper.

For any given flight, there will generally be a different four-dimensional (4D) trajectory calculated by the aircraft operator (for loading into the Flight Management System (FMS)), the Initial Flight Plan Processing System (IFPS), the Enhanced Tactical Flow Management System (ETFMS), and each Air Traffic Service Unit (ATSU) along the route.

Similarly, the destination airport frequently has only the original filed flight plan to indicate the expected arrival time of a flight (at least until the flight approaches the Terminal Management Area (TMA)), and military units may receive conflicting information concerning flights in areas which concern them.

In fact, none of the entities shown in Figure 3 has sufficient flight data synchronisation with the other entities for efficient operations. In particular, there is no common view of the downstream trajectory of aircraft.

This situation leads to today’s need to apply specific procedures to eliminate inconsistencies. Application of the procedures requires effort and resources from the stakeholders involved, with impact on capacity, cost, and operational efficiency. A failure in the procedures may result in a safety risk.

Furthermore, some of the main proposals for making better use of capacity in the future are:

* Integrated tactical flow and capacity management

* More delegation of tactical conflict resolution to the pilot (supported by suitable tools)

* More dynamic and responsive civil-military coordination, giving better exploitation of military airspace when made available for civil use

* Integrated arrival, departure, en-route, and surface management.

To deliver their full benefits, these proposals rely on the decision-makers concerned having more consistent, accurate, and up-to-date data about the flights than is available today.

The aim of Eurocontrol’s new Flight Data Interoperability Concept is to take advantage of the possibilities offered by modern technology to resolve the most significant flight data inconsistency problems identified.

EUROCONTROL’S CONCEPT FOR IMPROVEMENT OF FLIGHT DATA INTEROPERABILITY

Overview

In coordination with its stakeholders, Eurocontrol has developed a new concept to resolve the flight data interoperability problems in Europe, see Figure 4.

This concept will lead to the creation of a cost-effective, distributed information environment whereby all stakeholder systems (including airborne systems) have suitably controlled access to a set of “Flight Objects” describing the latest confirmed intentions of each flight which concerns them.

Eurocontrol’s concept is in line with section 2.9.2 “information management” of ICAO’s draft Global ATM
Fig. 2. Example of different vertical profiles calculated by an aircraft operator, ATFM and ATC.

Fig. 3. Overview of exchanges of flight data between stakeholder systems.

Operational Concept Document at [2], from which the following two quotations are taken:

"Information management will assemble the best possible integrated picture of the historical, real-time, and planned or foreseen future state of the ATM situation. Information management will provide the basis for improved decision-making by all ATM community members. Key to the concept will be the management of an information-rich environment."

"The ATM community will depend on information management, shared on a system-wide basis, to make informed collaborative decisions for best business and operational outcomes."
Overview of the Flight Object

For all stakeholders who need it, the Flight Object will be the single common reference about the flight, thus avoiding confusion and inconsistencies.

For each flight which is planned, currently active, or has taken place, there will be a "Flight Object" (FO) which contains the latest confirmed information about the flight, including such elements as aircraft type, estimate data, trajectory, equipment, weight, slot time, and stand number.

The Flight Objects exist in a common FO environment, which is a logical concept not implying any particular physical architecture. The specification of the optimum logical architecture for the common FO environment is one of the tasks of the Flight Data Management (FDM) activity conducted at Eurocontrol in coordination with the stakeholders. It is also a direct contribution to Eurocontrol's Overall ATM/CNS Target Architecture (OATA) Project at [1].

The information within a FO is held in Data Elements relating to the flight. The data elements may be held at a unique location or may be distributed over several different servers. The essential principle is that for any stakeholder the FO appears as a logical entity even if it is physically distributed.

The Common FO environment resolves the limitations of today's flows of flight data by ensuring that all stakeholder systems can (with appropriate authorization) access a definitive, consistent FO that describes each flight—planned or active—in the European area.

Creation of Flight Objects

Each FO is associated with a particular flight, and is initially created by the corresponding Aircraft Operator. After the flight has terminated, the FO will continue to exist, with all of the information about the history of the flight, but may be moved to an archive with longer retrieval time than the main Common FO environment.

Data Ownership

Each of the Data Elements in the FO will have an "owner." This "ownership" helps to determine the approval process for any changes to the contents of a Data Element in an FO. The owner of some Data Elements in a particular FO may differ from the owners of other Data Elements of the same FO, and may be formally handed over from one stakeholder to another at defined points in the flight life-cycle.

In some cases, several Data Elements may have the same "owner" and could be treated as a group from the point of view of ownership.

The rules and procedures for ownership are to be determined by Eurocontrol's FDM activity, in coordination with related activities.

In principle, the contents of a Data Element in an FO must be agreed with any appropriate authorities charged with the safe conduct of the flight within a specific volume of responsibility and coordinated and approved by the current owner.
Some Data Elements in the FO may be seen as a “Contract” between the stakeholders to ensure the flight is carried out as accurately as possible according to their agreement.

**Use of the Flight Object Environment by Applications**

An essential cornerstone of the FDM Concept is that the applications in stakeholder systems (e.g., Medium Conflict Detection or Arrival Manager applications in ATC Units, or Slot Allocation in ATFM) use the Common FO environment as their primary source of flight data. In addition, stakeholder systems may maintain their own copies of the flight data, external to the Common FO environment, for performance or other reasons (this is a technical implementation issue).

Stakeholder systems may also add details to copies of the FOs held externally to the Common FO environment, for their own purposes (e.g., detailed trajectory information). Only if such details are of interest to at least one other stakeholder and have been approved by the corresponding Data Element owner, should they be made available to other stakeholders via the Common FO environment.

Rules must be defined for what information should be made available in the Common FO environment, and at what time in the life-cycle of the flight this should take place.

**Access and Subscription Services**

All stakeholders are provided with controlled access to the latest confirmed, consistent version of the Data Elements in the FO, for whatever purposes their mission may require.

To facilitate systematic access by certain stakeholders, a subscription service may also be provided, so that all updates to those Data Elements that concern them would be sent automatically.

**Procedures and Rules**

The above-mentioned high-level principles of the FDM Concept must be refined with procedures and rules that answer questions such as the following:

- **At which moments in the flight data life cycle should the Common FO be updated?**

- **When an update is made, which stakeholders should be involved in approving the update?, and Which stakeholder systems actually submit the agreed update?**

- **What read access rights should be granted to each stakeholder to the Common FO environment for each life-cycle phase of the flight data?**

- **In which cases should a subscription service be offered to stakeholders to receive flight data updates?**

- **What rule should determine whether an element of flight data should be held internally to the Common FO environment, or held externally?**

For example, is it sufficient to say that any data element of interest to more than one stakeholder should be held in the Common FO environment?

One of the tasks of the FDM activity will be to provide answers to these questions. The FDM Concept will be updated to take account of the answers when they become available.

**Standards**

After it has been thoroughly tested and validated, it is intended that the access interface to the Common FO environment, including data and service definitions, will be submitted to a European standardisation body, in cooperation with the Eurocontrol Regulatory Unit and the European Commission.

Subsequently, it is expected that the standard will be proposed to ICAO for consideration as a global standard.

To prepare for this global approach, coordination is taking place with the United States Federal Aviation Administration (FAA), and was the subject of a joint Eurocontrol/FAA Flight Object Workshop in Brussels in September 2003. Follow-on activities between the FAA and Eurocontrol are planned for 2004.

**EVOLUTION TOWARD THE FDM CONCEPT**

For convenience of managing the activities which will realise the FDM Concept, they will be divided into those which are applicable in the Short-term, Medium-term and Long-term.

However, this is only a question of presentation, and these activities should be seen as evolutionary steps which will permit smooth operational and technical transition between each other.

For the Short-term (operational by 2004-2005), the improvements will be aimed at streamlining existing processes and procedures to improve information flows within the existing infrastructure.

For the Medium-term (operational by 2006-2007), there may be some changes proposed to existing data sharing and operational concepts; for instance, to support the transmission, reception, and processing of a few new messages, or adaptations to existing messages. Some existing interface standards may be updated to implement these changes.

The Long-term (operational by 2008-2010) goal is to realise the FDM Concept described above. Transition from today’s peer-to-peer message-passing mechanisms to the future FO environment will be achieved in an evolutionary manner, probably by deploying the FO environment initially in limited regions, and then gradually spreading out as experience and confidence are gained in the new concept.

**CONCLUSION**

The drive for greater cost-effectiveness and improved safety/security in an environment of increasing air movements calls for improved availability of accurate and consistent flight data to stakeholder systems.
Eurocontrol has developed a new concept for flight data interoperability which has been endorsed by its stakeholders. From this concept, a draft interoperability standard for the exchange of Flight Object data will be derived, with a view to deployment of systems complying with that standard in the 2007-2010 timeframe.

After initial consideration by European standardisation bodies, it is intended that the draft standard will be proposed to ICAO for global standardisation.

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Are Inkless Fingerprint Sensors Suitable for Mobile Use?

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ABSTRACT

This paper presents an evaluation of the main differences between fingerprints obtained from a low cost inkless sensor and from the classical ink-and-roll fingerprint images used in police applications. Our experiments reveal that although the image size and quality are quite different, it is possible to introduce the inkless fingerprint into the police database and to obtain a correct identification. This shows there is room for proposing a remote fingerprint identification from a police car, using the GSM mobile telephone network.

INTRODUCTION

Fingerprint identification is a well established and accepted method for person identification. Police departments have databases with the fingerprints of people with criminal antecedents, and use them to solve thousands of crimes and avoid illegal activities.

A common task for a policeman is to check the identity of suspects. Nowadays, this is mainly achieved by means of a visual inspection of the ID or passport. This document is manually checked in front of the suspect. This procedure has several drawbacks:

- It is limited by the ability of the policeman to identify faces (the document can belong to a different person).
- The ID or password can be faked, or the individual can have several different identities, each with a valid ID.

- If the policeman’s decision is wrong, a person can be wrongly released or wrongly taken into custody, with the consequent inconveniences.

Thus, there is a strong interest in the possibility to check the identity of a suspect by matching his fingerprint against the police file system, without complicated procedures that are time-consuming and/or mean taking the individual to the police station.

In this sense, our research team is collaborating with the state police to develop a whole system for remote fingerprint identification. This article is the first step toward this goal, and it focuses on the viability of using low-cost inkless sensors. Although remote fingerprint devices are not available or used nowadays, we think our experiments reveal the possibility to construct such systems and introduce them in real fields at low cost.

FINGERPRINT SENSORS

During the last decades several low-cost sensors have appeared. They can be classified into three categories:

- Optical sensors,
- Solid-state sensors, and
- Ultrasound sensors.

The last are not ready for mass-market application yet. Thus, almost all sensors can be classified as optical or solid-state. In [1] it is possible to find a recent and exhaustive list of commercial sensors. Their main advantage is their cost is below $200. On the other hand, there are more professional devices for rolled fingerprint acquisition but their cost, size, and power consumption are higher. In [2], it is possible to see examples of these products and special printers.

Figure 1 compares a fingerprint acquired with a digital persona scanner U.are.U [3] (optical technology) and a Precise Biometrics [4] scanner Precise 100 MC (solid-state technology). In our experiments we have chosen the optical sensor. This same sensor has been selected by the US Department of Defense (DoD), which has purchased 1,300 U.are.U fingerprint recognition systems to enhance network security at desktops within its Washington, DC offices [5].
computer system requires at least 7 characteristic points (minutiae), and 8-12 are necessary for use as proof in court. Using the flat inkless fingerprints about 15-20 minutiae can be extracted with no problem.

Figure 3 shows the fingerprints (10 repetitions of the same finger) used for testing purposes.

Comparing Figures 2 and 3, we see that, in addition to different fingerprint sizes, another important difference is that some distortion can be appreciated on the optical sensor, at the image borders.

**EXPERIMENTS AND RESULTS**

In order to evaluate the feasibility of fingerprint identification using the Automated Fingerprint Identification System (AFIS) shown in Figure 4 using the low cost ink-less sensor U.are.U, the following procedure is proposed:

<table>
<thead>
<tr>
<th>Fórmula dactiloscòpica</th>
<th>Núm. de fúixa policial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Núm. de clià</td>
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<tr>
<td></td>
<td>Ressenyat per Signatura</td>
</tr>
<tr>
<td></td>
<td>Núm. d'ag</td>
</tr>
<tr>
<td>Formulada per</td>
<td>Pota la recerca per</td>
</tr>
</tbody>
</table>

![Fig. 1 The same fingerprint acquired with an optical and solid-state sensor](image_url)

![Fig. 2. Ink-rolled fingerprint used for training the system](image_url)

It is important to emphasize that police fingerprint applications rely on rolled fingerprint acquisition rather than on flat fingerprint acquisition. Rolled fingerprints provide wider fingerprint surface, more characteristic points can be extracted, and thus, a greater feasibility for identification.

Figure 2 shows the fingerprint introduced in the computer for comparison purposes. It has been acquired with the classical ink method and special paper used in police files (rolled fingerprint). Rolled fingerprints are acquired from nail-to-nail borders. Although low cost inkless scanners just acquire the centre of the fingerprint (a small portion of the overall fingerprint data), we have proved that they contain enough information for a correct identification. The police's

- **Database Acquisition**: Ten different fingerprints of the same finger are acquired. They belong to a policeman whose fingerprints quality is below the mean. Thus, if it is possible to identify him, better results are expected for others. Comparing the fingerprint quality of Figures 1 and 3 a lower quality on Figure 3 can be checked. This fingerprint presents line interruptions due to skin folds. Thus, the fully automatic minutiae extraction is not possible. Assuming that almost all of the fingerprints in the database have reasonable quality and that the possibility to identify individuals does not depend heavily on
the particular individual, the important aspect is to test the system with different realizations of the same fingerprint, rather than using a large number of people.

- **Fingerprint Preprocessing:** In our case, the data acquisition software has been specially developed for this purpose, using the System Developer Kit (SDK), which can be purchased from Digital Persona. This program produces bmp files at a 72 dpi resolution and a size of 3.6 inches × 5.6 inches. Using Adobe Photoshop software, these images are fitted into 500 dpi and 0.5 inches × 0.8 inches. Thus, the images do not suffer any increase or reduction in resolution. They are adapted for real-scale printing in suboptimal conditions, because it has been done on a low-cost laser printer, using recycled paper (thus, the background is not fully white).

- **Identification:** The fingerprints are introduced into the AFIS 2000 system by Printrak International, Inc., using its own scanner (see Figure 4). The input fingerprint is matched against the whole database, which contains 450,000 different fingerprints. The score obtained in each test is tabulated and ranked with the 30 most probable identities. The first trial does not have enough quality (see Figure 3), so it has been discarded. Table 1 shows the results for those fingerprints that have been identified in first position, and Table 2 the results where the identity would be wrongly assigned taking into account the highest score. Anyway, in these cases, the differences among consecutive scores are not as high as for Table 1, and the correct identity is one of the first three. These figures

<table>
<thead>
<tr>
<th>Trail #</th>
<th>Score</th>
<th>Score for Option #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4,185</td>
<td>2,725</td>
</tr>
<tr>
<td>2</td>
<td>2,160</td>
<td>1,706</td>
</tr>
<tr>
<td>4</td>
<td>2,705</td>
<td>1,870</td>
</tr>
<tr>
<td>5</td>
<td>2,205</td>
<td>1,990</td>
</tr>
<tr>
<td>6</td>
<td>2,535</td>
<td>1,495</td>
</tr>
<tr>
<td>7</td>
<td>2,200</td>
<td>1,675</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trail #</th>
<th>Position</th>
<th>Score</th>
<th>Score for Option #1</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3rd</td>
<td>1,625</td>
<td>1,695</td>
</tr>
<tr>
<td>8</td>
<td>2nd</td>
<td>1,705</td>
<td>1,765</td>
</tr>
<tr>
<td>9</td>
<td>2nd</td>
<td>1,950</td>
<td>2,090</td>
</tr>
</tbody>
</table>

Table 1. Results for the successful trials (the fingerprint is identified in first position)

Table 2. Results for the unsuccessful trials (the fingerprint is ranked below the first position)

*Fig. 3 Ten inkless flat fingerprints used for testing*
could be improved with a different supervision of the minutiae extraction, using the same fingerprint image. We have considered the situation where the operator does not know if the result is correct or not, so the minutiae have not been trimmed. Anyway, the tight margin between the first score and the next, and the low scores are indicative of an insufficient minutiae adjustment. Figure 5 shows the screen with the results achieved for test number 6. The scores of the most probable identities and their respective fingerprint can be seen.

These results are not surprising if we take into account that police databases are designed and used to manage small fingerprint sizes, corrupted by dust, located on curved surfaces, etc. Figure 6 shows a typical fingerprint image obtained from an ocular inspection in a crime scene. A plot of a centimeter is included in order to see the real image dimension.

POSSIBILITIES FOR REMOTE FINGERPRINT IDENTIFICATION

Taking into account the results of the previous section, it is possible to think of a remote fingerprint identification procedure using a low cost inkless fingerprint scan. The procedure is summarized in Figure 5. It consists mainly of the following steps:

- The fingerprint of the suspect is acquired by means of the scanner. This device is powered by the car battery.

- The image file is transferred from the sensor device to a mobile phone using the RS-232 or USB port.

- The image is sent by the telephone (MMS messages with a conventional GSM mobile phone or multimedia file with a GPRS phone). The signal is electromagnetically radiated from the mobile phone to the nearest base station, and then conducted by the public-switched telephone network. This file is sent by e-mail to the police main station.

- A manual operator prints the image and supervises the fingerprint feature extraction, in a similar way as for fingerprints obtained in crime scenes or from police sheets with fingerprints (similar to that shown in Figure 2).

- The operator at the police central station communicates whether the suspect is to be released or arrested.

Obviously, this procedure can easily be adapted to be fully automatic with a main fingerprint computer system that accepts external images in standard formats (bmp, jpg, tiff, etc.), but this is not the case with the presently available system AFIS 2000 Printrak shown in Figure 4. On the other hand, a data-encryption procedure can be included to secure the transmission of the fingerprint image.

Although embedded wireless solutions including biometrically-enabled cell phones and other mobile personal communication devices with fingerprint scanners exist on the market, they are closed products that just permit verifying the identity of the owner. Thus, a special adaptation device from the scanner to the telephone should be designed for police applications.

CONCLUSION

The main result is that we have checked the possibility to enter flat inkless fingerprints into the main fingerprint file system. Although the image quality and size are different, we have proven that it is still possible to perform an identification. This reveals the possibility for developing a low-cost remote fingerprint identification system, taking advantage of the existing fingerprint identification systems used by police departments everywhere.

ACKNOWLEDGEMENTS

I want to thank Santi G. Tugores, Jordi Costa, Gabriel Costa-Tarrida and Xavier G. de Linares from the Catalan Policía-Mossos d’Esquadra for their support and collaboration on police premises. Indeed, this project would not have been possible without their contributions.
Fig. 5 A screen with the results for trial number 6. On the top left, the inkless fingerprint can be seen; on the top right, the rolled-ink fingerprint. Bottom left, there are the most probable fingerprints; and bottom right, the scores for the best candidates in the database.

Fig. 6 A typical latent print lifted from a crime scene found on ocular inspection. The fingerprint is presented at real size.

Fig. 7 The proposed scheme for remote fingerprint identification.

REFERENCES


A Brief History of UWB Antennas

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Next-RF, Inc.

ABSTRACT

This paper provides an historical overview of ultra-wideband antennas presenting key advances at the root of modern designs.

INTRODUCTION

"Ultra-wideband" has its roots in the original "spark-gap" transmitters that pioneered radio technology. This history is well-known and has been well documented in both professional histories [1-2] and in popular treatments [3]. The development of UWB antennas has not been subjected to similar scrutiny. As a consequence, designs have been forgotten and then re-discovered by later investigators. This paper aims to fill this void by offering a brief history of UWB antennas.

SPARK GAP DAYS

Ironically, the very patent which inaugurated the concept of narrowband frequency domain radio also disclosed some of the first ultra-wideband antennas. In 1898, Oliver Lodge introduced the concept of "syntony," the idea that a transmitter and a receiver should be tuned to the same frequency so as to maximize the received signal [4]. In this same patent, Lodge discussed a variety of "capacity areas," or antennas, that will be quite familiar to modern eyes:

"As charged surfaces or capacity areas, spheres or square plates or any other metal surfaces may be employed; but I prefer, for the purpose of combining low resistance with great electrostatic capacity, cones or triangles or other such diverging surfaces with the vertices adjoining and their larger areas spreading out into space; or a single insulated surface may be used in conjunction with the earth, the earth or conductors

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Fig. 1. Lodge preferred antennas consisting of triangular "capacity areas," a clear precursor to the "bow-tie" antenna (1898)

Fig. 2. Lodge's biconical antennas (1898)

embedded in the earth constituting the other oppositely-charged surface" [5].

In what is likely the most profound and sweeping sentence in the history of antenna technology, Lodge disclosed spherical dipoles, square plate dipoles, biconical dipoles, and triangular
or "bow-tie" dipoles. He also introduced the concept of a monopole antenna using the earth as a ground.

In fact, Lodge’s patent drawings make very clear his preferred embodiments. Figure 1 shows Lodge’s second figure in which triangular or bow-tie elements are clearly indicated. Figure 2 depicts Lodge’s fifth figure in which biconical antennas are unmistakenly used in a transmit-receive link.

ANTENNAS FOR SHORT WAVES

As frequencies increased and waves became shorter, the economic advantages of a “thin-wire” quarter wave antenna overrode any performance advantages of Lodge’s original designs. With the advent of research into television however, interest in antennas that could handle the much wider bandwidths associated with video signals increased.

This renewed interest in wideband antennas led to the rediscovery of the biconical antenna and conical monopole by Carter in 1939 (see Figures 3A and 3B) [6]. Carter improved upon Lodge’s original design by incorporating a tapered feed (see Figure 4) [7]. Carter was among the first to take the key step of incorporating a broadband transition between a feed line and radiating elements.

Schelkunoff proposed elaborate conical waveguides and feed structures in conjunction with his spherical dipole (see Figure 5) [8-9]. Unfortunately, Schelkunoff’s spherical dipole antenna does not appear to have seen much use.

Perhaps the most prominent UWB antenna of the period was Lindenblad’s coaxial horn element [10-11], Lindenblad
improved on the idea of a sleeve dipole element, adding a gradual impedance transformation to make it more broadband. RCA chose Lindenblad’s element (seen in cross-section in Figure 6A) for experimental use in television transmission. RCA envisioned multiple channels being broadcast from the same central location, thus a wideband antenna was essential. For several years during the 1930s, a turnstile array of Lindenblad’s coaxial horn elements graced the top of the Empire State Building in New York City where RCA located its experimental television transmitter. Figure 6B displays a patent drawing of this array. The antennas at the top of the tower in Figure 6B (items 70-72) are folded dipoles used to transmit the audio portion of the television signal. Kraus developed a design similar to Lindenblad’s coaxial horn element and dubbed it a “volcano smoke antenna” [12].

In fact, Lindenblad’s coaxial element came to symbolize the entire television research effort. This UWB antenna has the
Fig. 14. Marié’s wide band slot antenna (1962)

Fig. 15. Harmuth’s large current radiator (1985)

distinction of being perhaps the only antenna featured prominently on the cover of a mainstream periodical [13].

Other researchers pursued the idea of constructing antennas from coaxial transitions. Brillouin introduced coaxial horns, both omni-directional (as in Figure 7) and directional (as in Figure 8) [14].

Designers also explored other traditional horn designs during this period. Figure 9 shows one patented by King [15] and Figure 10 depicts another invented by Katzin [16].

FURTHER ADVANCES

Although existing designs offered excellent performance, other consideration became important. As broadband receivers came into common use, emphasis on inexpensive, easily manufacturable designs increased. The well-known “bow-tie” antenna originally proposed by Lodge and later re-examined by Brown and Woodward exemplifies these benefits [17]. Similarly, Masters proposed an inverted triangular dipole (see Figure 11) [18]. Later engineers rediscovered this antenna and dubbed it a “diamond dipole” [19].

More recent developments include a variety of more sophisticated electric antennas. Stohr proposed the use of ellipsoidal monopoles and dipoles as shown in Figures 12A and 12B [20].

More manufacturable antennas in this genre were pioneered by Lalezari et al who invented the broadband notch antenna depicted in Figure 13A [21]. The planar circular element dipole of Figure 13B put forth by Thomas et al provides still better performance [22]. This antenna is compact, readily manufacturable, and easily arrayable. Improved performance can be obtained, however, by constructing dipoles using elliptical shaped elements instead of circular ones [23]. Planar elliptical elements also work well as monopoles [24].

Significant advances have also been made in magnetic UWB antennas [25]. Marié took the concept of a slot antenna and improved its bandwidth by varying the width of the slot line [26]. Figure 14 displays Marié’s antenna.

Harmuth suggested another improved magnetic antenna by introducing the concept of the large current radiator shown in Figure 15 [27]. Ideally, this magnetic antenna looks like a current sheet. Because the sheet will radiate from both sides, designers typically employ a lossy ground plane to limit undesired resonances and reflections. This tends to limit the efficiency and performance of large current radiators.

Barnes pioneered a novel UWB slot antenna [28-30]. Barnes’s slot antenna (shown in Figure 16) maintains a continuous taper. The Time Domain Corporation’s first generation through-wall radar, the RadarVision 1000, utilized this antenna. With proper design of the slot taper, excellent broadband matching and performance can be obtained.

CONCLUSION

The past century witnessed the development of an incredibly wide variety of UWB antennas. This paper highlights a few particularly noteworthy UWB antennas as a starting point for further explorations.

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Microsatellite Combined Attitude/Energy Systems

Eunjeong Lee
Korea Advanced Institute of Science and Technology

ABSTRACT

We have constructed a high-temperature superconductor-magnet momentum wheel for microsatellites and propose a micro high-temperature superconductor energy storage and attitude control system for nano/pico satellites.

The momentum wheel for micro satellites has a mass of 1.1 kg with an angular momentum capacity of 3.5 J sec. It occupies a volume of 12.7 cm in diameter and 5 cm in height. It operates within the restricted power budget of a microsatellite with a total power supply of only 10 watts. It consumes less than 1 watt for sustenance.

The micro high-temperature superconductor flywheel for nano/pico satellites has an angular momentum capacity of 0.083 Js and stores 2.32 kJ at 530 krpm. Its energy storage capacity is approximately 45 Wh/kg with an energy density of around 370 kJ/L.

The HTS systems can perform the dual function of a power/attitude control system and are ideally suited for low earth orbit energy storage, power generation, and attitude control of spacecraft.

INTRODUCTION

Recently, with the increased use of satellites, there have been demands for lighter and smaller satellites with reduced launch costs. To meet these challenges, we have developed a high-temperature superconductor (HTS) – magnet momentum wheel for attitude control of microsatellites in low earth orbit and propose a micro HTS-magnet bearing system for attitude control and energy storage of nano/pico satellites.

The rationale for use of this HTS system derives from the unique capability of the HTS to adapt to low temperatures, radiation, and vacuum environments in space and to enhance system stability passively without power consumption. The HTS-magnet bearing system has high angular momentum storage capacity because its drag torque is essentially velocity-independent and extremely small, enabling high-speed rotation [1].

The high-speed rotation can make high accuracy attitude control systems with good disturbance rejection. This property can be obtained when the system can respond quickly to external disturbances. In other words, high bandwidth is required for better disturbance rejection.

High-accuracy positioning systems also require smooth motion. Hence, absence of friction is very important in attitude control systems because friction causes closed-loop instability [2]. Moreover, static friction at near-zero velocities causes limit cycling in closed-loop systems, or makes the motion discontinuous or jerky. It is very difficult to control the momentum wheel when it passes through zero velocity, i.e., when it has to change direction or start to rotate. HTS-magnet bearings eliminate such friction by levitating the rotating structures.

Thus, the HTS systems can perform the dual function of a power and attitude control system using flywheel elements for both power storage and attitude control [3]. This dual function capability further reduces the mass of the spacecraft.

In the second part of this paper, a micro HTS energy storage and attitude control system is proposed for space applications. For nanosatellites in low earth orbit (LEO), where missions require more than 40,000 charge/discharge cycles [4], the HTS-magnet energy storage system is ideally suited because the HTS flywheel can last more than 100,000 charge/discharge cycles. This system also offers an attractive power supply and energy storage system for use during solar nights or in Geosynchronous Orbit (GEO) and deep space where the environments are cryogenic temperatures.

The organization of this paper is as follows: the next section describes an HTS-magnet bearing system; following that, the section discusses the HTS-magnet momentum wheel; the section entitled "Micro HTS Power Supply" describes a micro HTS energy storage and attitude control system; which is then followed by the section that discusses future work indicated and conclusions reached to date.

HTS-MAGNET BEARING SYSTEM

Besides the remarkable current carrying capacity above a critical temperature, a superconductor has the property called
diamagnetism, which is exclusion of flux from a material. When a superconductor is placed in a magnetic field, it tries to minimize the magnetic flux density, and thus expels the magnetic flux from its body [5]. For example, when a permanent magnet is placed above a diamagnetic body like a superconductor, the induced superconducting currents in the superconductor act to exclude the total flux from it. These currents act as repelling magnets and levitate the permanent magnet [6]. The effect of diamagnetism can be explained by the following.

In a magnetic material, the magnetic field flux density \( B \) and the magnetic field intensity \( H \) differ by the physical magnetization density in material bodies \( M \):

\[
B = \mu_0 (H + M),
\]

where \( \mu_0 \) is the permeability of a vacuum (\( \mu_0 = 4 \times 10^{-7} \) in MKS units). \( M \) can be induced by external fields. For nonferromagnetic isotropic materials we can write the following constitutive law:

\[
M = \chi H,
\]

where \( \chi \) is the magnetic susceptibility. Suppose that \( B \) becomes zero in Equation (1) due to the diamagnetism, then \( \chi = -1 \). Hence, the material can be thought of as having a negative magnetic susceptibility [6]. In other words, the magnetization inside a diamagnetic body like a superconductor is aligned opposite the applied magnetic field, resulting in a repulsive force.

A superconductor also tries to keep the magnetic flux within itself constant when it experiences a magnetic field change. It can be illustrated by a permanent magnet ring levitated on top of a disk of HTS. If we pull the permanent magnet away from its center of rotation, i.e., if we try to decrease the magnetic flux, the HTS brings the permanent magnet back to its original position to keep the magnetic flux constant, and thus provides inherent stability. This property is known as a flux pinning effect.

Superconductor-magnet bearing systems are based on passive magnetic levitation and the flux pinning effect described above. In the following section, we discuss the development of an HTS-magnet momentum wheel.

**HTS-MAGNET MOMENTUM WHEEL**

We have developed an HTS-magnet momentum wheel for microsatellites in low earth orbit that require attitude control under a low energy/power budget. It is made of aluminum and has a mass of 1.1 kg with an angular momentum capacity of 3.5 J sec at a speed of 12,800 rpm. It occupies a volume of 12.7 cm in diameter and 5 cm in height. It operates within the restricted power budget of a microsatellite with a total power supply of only 10 watts.

The levitated HTS-magnet momentum wheel is shown in Figure 1. It has a groove in the middle to accommodate a non-contact motor in the future. The wheel has a permanent magnet, NdFeB, which is made up of two concentric rings of opposite polarity [7]. During operation, it is directly on top of a disk of YBaCuO HTS with a gap of a couple of mm. The HTS and magnet keep this position by diamagnetism and flux pinning effect of HTS.

Spin down tests demonstrated low power consumption (25 mW average and 250 mW peak) for rotation with constant velocity of 60 rpm in air. Power was supplied by a standard 9 volt dry cell battery. The wheel has been spun up to an estimated 2,500 rpm by an induction motor. It has gradually slowed down for 15 minutes. The wheel is observed to wobble when it breaks through the natural frequency, which is less than a few hertz. Above the critical speed, it is observed to rotate with near-zero eccentricity.

Special design considerations were given to the limited energy budget available to a microsatellite. Power consumption of motors and the cryogenic cooling system for a superconductor magnet momentum wheel was optimized for minimum overall power consumption.

A miniature cryocooler with a low power consumption capable of keeping the HTS at the low temperature (77 K) required in the low earth orbit space environment (<1750 km) was identified commercially available. This sterling cycle cryocooler has a cooling power of 250 mW at 80 K. Input power is less than 6 W. One unit is sufficient for the momentum wheel that requires only 0.03 W at 77 K. It has a small mass of 0.45 Kg. The main body is a cylinder with a diameter of 55 mm and height of 65 mm.

A motor design is very important in the development of a momentum wheel because the motor power consumption can contribute significantly to the overall power consumption. To be integrated with the wheel, the motor should satisfy the stringent system requirements, such as low power consumption, light-weight, and non-contact and miniature design. Moreover, special considerations must be given to meet space qualifications at vacuum environment and cryogenic temperatures. DC brushless motors have been chosen since they meet the low power dissipation requirement and also provide a precise control of torque/position.

Our conceptual design brings forth an ironless DC brushless motor with three phases and multipoles. It is similar to the DC
brushless motor developed by NASA Goddard Space Flight Center for a magnetic bearing equipped optical chopper for a spaceflight radiometer [8]. It consists of two rare-earth permanent magnet ring rotors, NdFeB, and the stator fabricated using printed circuit board (PCB) manufacturing techniques. The stator is multilayered to decrease the eddy-current loss when it experiences alternating magnetic field due to multipoles. The radial forces, which result in additional disturbances, are eliminated by removing iron at the stator.

The configuration of the motor is shown in Figure 2. The stator is clamped into the housing. The momentum wheel is made of two pieces so it can be inserted through the hole of the stator. The multipole magnets are located around the rim of both sides of the momentum wheel. Three pairs of Hall effect sensors will be mounted for motor commutation inside the housing near the multipoles. This motor is in the design optimization stage, and will be integrated with the momentum wheel along with the cryocooler.

Table 1 shows the total estimated power consumption when this motor is used for sustenance of constant rotational velocity of 13,000 rpm in vacuum [9]. Power requirements for control electronics are not included. It consumes less than one watt for sustenance as shown in Table 1.

**MICRO HTS POWER SUPPLY**

**Structure**

A schematic view of the HTS micro energy system is shown in Figure 3. This system consists of an HTS-magnet flywheel energy storage system and a brushless motor/generator. The generator armature planar coil has multi-layers and will be deposited on the surface of the stator of the flywheel that encloses the HTS. The rotor of the flywheel has alternating permanent magnet poles for the motor/generator and a permanent magnet for its levitation above the stator that includes the HTS disk. HTS Pulse-width modulation (PWM) power electronics will be integrated into the same Si substrate for the stator. A Hall effect sensor mechanism will be incorporated near the outer rim of the stator coil for commutation. Piezoelectric actuators will be incorporated into the housing to hold the flywheel in place before the HTS cools to a cryogenic temperature. This entire system will be made using vacuum packaging technology to avoid aerodynamic drags against the wheel.

The stator is made of multi-layers to confine eddy currents to a single layer, significantly reducing eddy current loss. For the stator, MgO is chosen as the interstitial layer due to its ease of deposition on HTS yttrium barium copper oxide (YBCO), ease of wet etching, and compatibility with existing CMOS technology [10]. YBCO will be deposited on MgO, which, in turn, will be deposited on the Si substrate. In order to produce high motor torque, the conductor path on the stator is laid out in a meander shape that has radial and tangential components as shown in Figure 3 [8]. The alternating permanent magnet arrays on the rotor can be fabricated using electroplating technique and wafer bonding [11].

The heat dissipated will be collected through a thermal conduction path deposited on the outer rim of the motor stator. The thermal paths are connected to a large metal surface to dissipate thermal energy. To reduce heat conduction between the cryogenic HTS and the rest of the system, an air gap will be fabricated above the HTS as shown in Figure 3. The diameter of the HTS disk is significantly larger than its height. Thus, we can assume that heat conduction from the side of the HTS disk will be negligible.

**Operation**

In the HTS micro energy system, the motor/generator mode is determined by the connection between multi-layers of the stator. In the generator mode, the stator coil layers will be connected in series to increase the armature voltage that generates electricity for spacecraft. In the motor mode, these layers will be connected in parallel. When the switch is closed, current flows from solar cells through the armature coil, generating torque on the permanent magnets of the rotor to
spin the wheel. The rotor flywheel can store this kinetic energy. It can also use its momentum for attitude control of a spacecraft. During solar nights, the system can be switched to a generator mode. Then, the rotating permanent magnets on the rotor will induce a voltage in the stator coil to supply power for the spacecraft. Switching between the modes, the motor commutation and generated voltage rectification is done by HTS PWM power electronics.

Integrated attitude control and energy storage system can be achieved by using a pair of counter-rotating micro wheels. We can make rotors levitated on both sides of the stator based on passive magnetic levitation and the flux pinning effect of HTS. The coils can be deposited on both sides of the stator. This configuration enables nanosatellites to change their angular momentum and orientation with very little corresponding net change in stored energy.

**Energy**

The dimension of the HTS system is given in Table 2. The diameter and height of the rotor are 30 mm and 4 mm, respectively. The rotational velocity of 530 rpm gives the maximum stress of $7 \times 10^5$ dyne/cm² [12,13], which is an order of magnitude below the yield stress of Si, $7 \times 10^6$ dyne/cm² [14]. The rotational kinetic energy that this HTS flywheel can store is 2.32 kJ. The wheel has a capacity of angular momentum storage of 0.083 Js. Assuming negligible energy loss, the energy density is 410 kJ/L and the specific power is 49 Wh/kg [12]. However, the system dissipates energy in the form of eddy current loss, AC hysteresis loss on HTS, and Joule heat. The AC hysteresis loss can be minimized by optimizing the radius of the HTS and the wheel so permanent magnet poles can be as far as possible from the HTS.

For the given dimension in Table 2, the HTS bearing may move 350 μm radially under the disturbance of 5g (gravitational constant) [15-17], but its strong stiffness (10–20 kN/m) will bring it back to its original position. Even though the HTS-magnet bearing shows high radial and axial stiffness, it will require additional analysis of rotor dynamics and experiments to achieve stable rotation. The above HTS system can provide slewing rate of 25 deg/s for nanosatellites whose radius, height, and mass are 20 cm, 30 cm, and 10 kg, respectively.

**Energy Loss**

Table 3 shows a summary of the predicted energy loss for the HTS system. Note that the total energy loss is less than 10 mW. If the total heat dissipation is less than 10 mW and the cooling temperature is above 80 K in space environment, passive radiative cooling can be used to cool the high temperature superconductor down to 80 K [18].
A thermal path is made at the outer rim of the motor stator and additional thermal layers can be inserted between the stator layers for effective thermal dissipation. The dimensions of the thermal path and metal surfaces will be optimized for effective heat dissipation. An air gap is designed above the HTS to serve as an effective thermal isolation [10, 19].

The use of cryogenic HTS electronics can significantly reduce energy loss. The energy loss due to HTS electronics is approximately 10% of that of semiconductor electronics because the thermal conductivity of silicon material increases about nine times when the temperature decreases from 295 K to 77 K [21, 22].

CONCLUSION

We have developed an HTS-magnet momentum wheel for microsatellites and proposed a micro HTS-magnet energy storage and attitude control system for nano/pico satellites. The HTS-magnet systems have many promising features. Their extremely small and velocity-independent bearing loss enables high angular momentum storage within a small volume and mass. Their inherent system stability allows simple control systems. Their low power consumption is also advantageous over active magnetic bearings in space where a source of power is scarce. Furthermore, they can perform the dual function of power/attitude control system using flywheel elements for both power storage and attitude control.

These levitated wheels do not impart undesirable disturbances into the spacecraft nor excite its structural resonances since their vibration is isolated. These features make the HTS-magnet bearing system an ideal technology for NASA’s Space Interferometry Mission in which individual optics on the structure must maintain relative positions and orientations accurately. This system will also enable high accuracy formation flying of satellites and spacecraft for surveillance and communication networks. Low noise further facilitates accurate on-board scientific measurements. With further optimization, it can be the enabling technology to achieve the energy storage goal set by the Air Force and NASA.

However, careful design consideration must be made to estimate and allocate power between the function of attitude control and that of energy storage. For design optimization, the overall energy loss should be minimized while maximizing the driving motor torque to achieve high angular momentum storage.

Finally, future work involves design optimization using FEM software, fabrication, and experimental validation. Simulations and experiments will be performed to investigate rotor dynamics. The prototype power supply system will be integrated with control systems to test its dual function capability.

ACKNOWLEDGMENTS

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Curbing Gambling Activities on the Internet

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ABSTRACT

Gambling is prohibited in Taiwan, although it has existed in the society for a long time. With the emergence of the Internet in the past decade, not only is E-commerce being promoted, but Internet gambling as well. The negative influence of Internet gambling, however, is much greater than the impact of traditional gambling on our society. Due to the properties of anonymity, lack of boundaries, and the rapid spread on the Internet, it is becoming increasingly difficult for law enforcement to seize suspects who engage in illegal gambling. In this paper, we introduce some serious problems resulting from Internet gambling, and provide a procedure to investigate and curb the spread of Internet betting in Taiwan. According to our proposal, the information of evidence collected is believed to be presented conclusively in a court of law. Persons attempting to bet on the Internet should be deterred.

INTRODUCTION

Since 2000, the economy has gradually become depressed all over the world. The prospect, however far remote, of being made prosperous by winning the lottery has many people in Taiwan gambling. Even though the chance for winning the jackpot is less than one in a million, thousands upon thousands still enjoy betting. They always think that their luck will come to them in the next bet. With the prevalence of the Internet, many things can be accomplished easily by utilization of the Internet. Gambling is one of those many things. As a matter of fact, any gambling website can be found easily, simply by typing in any of the keywords, such as gambling or casino in the WWW search engine. And, since the cost for setting up a site is inexpensive makes the growth of Internet gambling even more rapid and ever more popular. Generally speaking, an Internet gambling club first needs to recruit members before activating a bet on the Internet. The basic enrollment procedure is to register the personal information via the website, and then the member account is sent back to the person who has registered on the web. For those who gamble on the Internet, the stake is either considered to be a number on their bank account or credit card. Once the gambler wins the bet, the stake will be settled and deposited to that person’s account. On the contrary, the amount of the stake will be withdrawn from the account if the gambler loses. According to the pointed survey of “Datamonitor” and “Greenfield Online” [7], the total income of Internet gambling amounted to US 6.6 billion dollars in 2001. The trend is further predicted that this will come to US 20.8 billion according to the report in [7]. When we look at the criminal code of Taiwan as it pertains to gambling, we see that it is confined to the traditional behavior of gambling and does not include the forms of gambling found on the Internet. This creates a problem when trying to investigate illegal behavior of Internet gambling. The issues of Internet gambling have received the attention of much literature [1, 4, 8], in which Internet gambling is always explained as an extension of traditional gambling. The characteristics of Internet gambling and the procedures for investigating illegal gambling on the Internet are seldom discussed. This inspired us to develop a better procedure to obstruct the criminal attempts of Internet gambling. This procedure is explored and presented as follows: In the next section, we give a brief introduction to the problems of Internet gambling; then the proposed procedure to curb Internet gambling is presented; and finally, our conclusions are given in the last section.

THE PROBLEMS OF INTERNET GAMBLING

According to the criminal code in R.O.C., the punishment for a criminal act must be based upon “the principle of legality.” The objective of “the principle of legality” is to restrain the power of the government and to safeguard the freedoms and rights of its citizens. Gambling is prohibited in Taiwan. Gambling encourages a mentality of “reap without sowing.” A person obsessed with gambling is a danger to his own well being as well as that of society as a whole. Therefore,
the criminal code of Taiwan prohibits gambling and has defined relevant punishments for those that do not uphold the public order and maintain good customs. Once gambling is allowed, its impact will be more serious than that of a lottery. The potential for gambling to cause severe social and financial problems are very real. Bankruptcy, suicide, matrimonial disputes and burglary are often the result when gambling takes hold. This, in turn, will result in a higher financial burden for society, because it must pay the increased cost for social institutions and law enforcement agencies to reduce the negative effects of gambling. According to the report in [6], the expenditure to social institutions and police agencies is triple that of any income gambling will produce in taxes for the government. Nevertheless, greed is part of human nature, and so gambling continues in one form or another. Moreover, cyberspace and the rapid growth of the Internet offer a convenient environment for a gambler. The key attractions and the associated potential problems of Internet gambling can be categorized as follows.

- There are a multitude of Internet gambling websites established in countries around the world which are not supervised by the government or law enforcement authorities of the country in question [2]. As a result, Internet gambling is running rampant.

- Internet gambling is a 24-hours a day activity — it never stops. A gambler can bet on the Internet at anytime, anywhere via networked computers, cellular phone, or PDA. In addition, there are no age restrictions.

- The stake in traditional gambling is generally paid in cash which cannot be used on the Internet. A digital number, such as a credit card number or financial account, is used instead in Internet gambling. As a result, credit card abuse is rapidly becoming a serious problem, especially for paying the stake of a bet on the Internet. However, gamblers like this method of payment (via credit card) because it is convenient, but, it is also susceptible to credit card fraud.

- Large amounts of e-cash transactions take place during Internet gambling. The stake of a bet can reach an astronomical figure. It is for that reason that hackers try to destroy the web site or steal the card numbers when stake transactions take place. As a result, the risk of Internet gambling is, in reality, much greater than that of traditional gambling.

- Money laundering is another illegal side product of Internet gambling. Because the administrators of the websites do not check the identities of gamblers to recruit large numbers of new members joining the Internet bet. As a result, Internet betting can readily be used by those criminal elements to engage in money laundering.

PROCEDURE FOR INVESTIGATING GAMBLING ON THE INTERNET

The procedure to investigate Internet gambling is similar to the investigation of traditional gambling but the environment has changed to the Internet. Therefore, how to retrieve and obtain evidence from the electronic magnetic media of the Internet becomes a hot issue in crime investigations. As a matter of fact, there are some literatures available on the procedure for seizing cyber-crimes. However, the retrieval of evidence and the task force required to probe the criminal motivation are always ignored in these papers. When it comes to Internet gambling, if a case comes to the attention of law enforcement, the first job is to validate the legality of what's happening on the web. Such verification can be done by the presentation of text and images as shown on the website. If the website is categorized as an illegal website according to the law on casinos, then police will assume the responsibility to stop the gambling activity. In this paper, we further propose a procedure in principle for seizing cyber-criminals, such as Internet gambling casino operators.

The procedure we propose can be summarized in two stages. First, raiding the Internet gambling site; and second, the collection of evidence of the crime venue. The first stage consists of three steps: 1) establish a task force for raiding Internet gambling; 2) reach a consensus between police and crown prosecutor as to the crime committed; and 3) negotiate an investigative process between the law enforcement agency and the press, respectively.

Stage 1: Raiding the Internet Gambling Site

- **Step 1. Establish a task force to raid the Internet gambling activity.**
  In response to the trend of cyber-crime, a cyber-crime task force devoted to the investigation of cyber-crime needs to be established. In addition, the steering committee of this task force should consist of members from the Institute for Information Industry, the bureau of telecommunication, the banking industry, Computer Emergency Response/Coordination Team (CERT) and the Criminal Investigation Bureau in order to draw upon adequate support. Of course, the team members of this task force must have adequate computer-related knowledge, such as computer systems, networking systems, computer forensics, and the applicable law codes, etc.
CONCLUSION

Nowadays the law on Internet gambling is still unclear under present Taiwan law. This situation has made the law difficult to be enforced, especially if the authorities try to do so under “the principle of legality.” This has become a serious problem. Internet crimes should be part of the judicatory process immediately so that prosecution of Internet gambling can be pursued effectively. At the same time, “the principle of legality” should be incorporated into the present law code to effectively curb Internet gambling. The efforts in tracking and investigating cyber-crime in Taiwan have been receiving considerable attention around the world. As a matter of fact, special task forces, such as the Computer Crime Investigation Squad of the Criminal Investigation Bureau and the computer crime squad in the local police departments have been set up to fight cyber-crime in Taiwan in the recent decade. Even so, it is still insufficient to take care of most cyber-crime. Therefore, in this paper, we proposed some basic solutions to Internet gambling problems. Our proposed procedure consists of two stages: the initial stage of raiding the Internet betting site; and the second stage: evidence collection of the crime venue. We believe that if the investigative procedure of raiding the Internet gambling site follows our proposal, the information collected by law enforcement will be valuable evidence and can be effectively presented a court of law. In this manner, the spread of Internet gambling can be curbed effectively.

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Differential GPS Dynamic Location
Experiments at Sea

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ABSTRACT

Differential GPS on board naval vessels has been tested in severe multipath archipelago environment against a commercial laser tracker system. The average location difference was 3 meters and two periodic error components were found. Their time constants were 1.8 and 28 seconds and the peak amplitudes 1.5 and 1.1 meters, respectively. In addition to these, a clear dependency of location error standard deviation figures on the GPS antenna mounting distance from the sea level was observed.

Fig. 1. Schematic presentation of multipath propagation close to a naval vessel

Fig. 2. Possible mounting places for GPS antennas on board the test vessel

INTRODUCTION

Naval navigation has, since the late 1980s, partly relied on GPS positioning, often supplemented by ground-referenced error data, which is provided through Differential GPS (DGPS) stations. If GPS-based location can utilize a close-by DGPS reference station, most of the deteriorating effects of the ionosphere and troposphere can be cancelled out [1]. In addition to this feature, the process can reduce factors created by the space segment although complete nulling is seldom feasible. One of the major problems not handled through the DGPS algorithm is the local multipath environment close to the GPS receiver [2] that is mounted on-board the navigating vessel. A number of improvements to the antenna systems have been proposed and implemented to counter this [3], for example, the corrugated collar. The multipath situation is clarified in Figure 1. Two main points can be seen. There are a number of alternative mounting positions available, which
Fig. 3. Principal layout for the tracking of the test runs with a ground-based laser.

Fig. 4. An example of tried antenna positions. The optical reflector for the laser is just below the antenna means varying reflections from the conducting surfaces of the ship. The sea surface can be another source of reflections, particularly if the GPS antenna is mounted on the lower deck.

Fig. 5. Typical GPS constellation above the test site during experiments. Satellite PRNs are indicated in bold.

Fig. 6. The raw location results with laser (dotted line) and DGPS (solid line) show good correlation.

[4]. Waves caused by the wind or the ship's motion further complicate the case. Especially distance measurements relying on the pseudo-code technique can be vulnerable to this phenomenon, yielding errors up to 10-20 meters [5]. Figure 2 depicts a set of alternative GPS antenna positions on the Navy test vessel.

TEST ARRANGEMENTS

The entire test campaign was carried out with one of the Finnish Navy's test vessels. Figure 3 shows a schematic view of the test installation. The ship was continuously tracked with a ground-based laser. A permanent reference point on the shore, provided by the National Board of Survey, was used in order to get absolute location data as well. Laser tracker
readings were recorded together with the respective DGPS information every 700 milliseconds as the ship was sailing back and forth along a predefined leg of approximately 1000 meters at 4.5 m/s speed. A separate navigation system was utilized in order to be able to repeat the same physical path an adequate number of times. The analysis described herein is based on statistics from 24 individual paths. In our case, the DGPS reference station was located 34 kilometers away [6]. An example of the real environment on the ship with the GPS receiver and laser beam reflector is illustrated in Figure 4. The prevailing satellite constellation was monitored as well. Figure 5 indicates a typical situation and points out relevant satellite PRNs as well. Considerable efforts and manipulation work was needed in converting obtained location data between different coordinate systems. Algorithms and guidelines were found in [7 and 8].

**RESULTS**

An example of our “raw” results is highlighted in Figure 6. The total length of the ship’s path is about 1000 meters, directed to about South-East (SE). Quite accidentally, we got also a turning maneuver to our recording, although we, in
principal, tried to avoid them due to apparent visual tracking problems (the laser reflector could be shadowed by the ship’s hull). The scaling of the plot does not allow any real judgment and therefore we show the difference between the laser tracker and the DGPS receiver in Figure 7. The result looks interesting. Of course, a bias of about 2.7 meters is evident, but the clearly periodic fluctuations are of even greater interest. There seems to be a rather slow (about 150 meters) decaying ramp and a much faster sine-like component in the difference track. A rather straightforward numerical frequency domain analysis reveals that the first frequency is about 0.54 Hz and the second 0.034 Hz as is shown in Figure 8. The respective momentary peak positioning errors are 1.5 meters and 1.1 meters. In time domain we are dealing with processes that have cycle times of about 1.8 seconds and 28 seconds. These numbers are based on averages, which were calculated from all successful paths. However, as can be seen in Figure 9, the slower saw-tooth-like fluctuation in location data had different frequencies during different runs.

Figure 10 illustrates the averaged two-dimensional positioning error that accumulated during all the presented test runs. No simple connection between antenna position and error vector direction was observed. There is, however some correlation between sailing direction and error behavior (not shown in this plot). This was observed as a slight rotation of the error vector pattern. Finally, Figure 11 shows a statistical view about the effects of the mounting position on the location uncertainty. Runs 2, 4, and 6 gave the smallest standard deviation of all (around 0.7 meters) and the GPS antenna was in those cases mounted at the highest available position on the upper deck. On the other hand, the standard deviation of runs 7-12 is largest, about twice as high. In these cases the GPS antenna was still completely unobstructed as seen by the satellites but was located very low on the deck, close to the sea surface. At the time of this writing, an in-depth analysis to find out the fundamental reasons behind our findings is on-going.

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Book Review

Millimeter-Wave Radar Targets and Clutter

Gennadiy P. Kulemin
Artech House, Norwood, MA
2003, 327 pages, Hard cover
ISBN 1-58053-540-2

Millimeter waves are generally defined as radio frequencies between 30 and 300 GHz. Initial serious trials to use them were apparently made during the Second World War. For example, German radar experiments were carried out up to 150 GHz in 1945, but with no practical success. The interest in applying very short wavelengths is partly based on the possibility of getting extremely wide modulation bandwidths whereby we could expect a tremendous increase in communications capacity. Putting 150 Mbit/s uncoded on a UHF carrier would consume the entire part of that spectrum region, but at 90 GHz, there might be some space left. Radar people have been fascinated by the size reduction of antennas feasible if higher frequencies are used. Clutter reduction – to a certain extent – and enhanced spatial resolution look possible. Millimeter waves have suffered from the lack of compact, easy-to-use high power amplifiers and the availability of cost-effective really low-noise front-ends has not been good either. Besides these technology issues, the fundamental characteristics of the propagation medium close to Earth at millimeter waves does not encourage long-distance hops except for a couple of limited “windows”; for example, at 94 GHz. Anyhow, the benefits have been considered adequate, and hard work is still ongoing. The book now under review, Millimeter-Wave Radar Targets and Clutter by Professor Gennadiy Kulemin is a compilation of recent activities and knowledge within this particular field.

Let’s first have a look at the structure of this book. It is divided into seven main chapters and contains an alphabetical index of about 900 items from which to search. Chapter 1 gives an introduction to the world of fundamental radar concepts, such as radar cross section, target characteristics and statistics, and elementary detection issues. In addition, there’s an interesting sub-chapter about radar reflections from explosions and gas wakes of operating engines. Here, the author also gives guidelines about the influence of a nearby surface on the statistical properties of target echoes. Chapter 2 is about land backscattering and includes a theoretical introduction and many experimental results. This approach is further extended in Chapter 3, where we have a rather detailed treatment of land parameter estimation through the use of multichannel radar signals. Sea backscattering at low grazing angles is the topic for Chapter 4. As usual, in these contexts, a lot of effort and lines are devoted to the definitions and explanations of different forms of surface perturbations during windy conditions. Chapter 5 concentrates on volume clutter coming from precipitation and other meteorological phenomena. Two special sections highlight experimental results and reflections from clear-sky radar angels. Simulation and modeling issues of surface clutter are treated in Chapter 6. Due to known differences, this discussion is split into land and sea environments. Finally, Chapter 7 gives basic guidelines for the reduction of clutter effects in millimeter-wave radar systems. The author has also included some interesting multipath examples within this part of his work.

The author, Professor Gennadiy Kulemin, got his master’s degree in radio engineering in 1960 from the Kharkov Polytechnic Institute and received his Ph.D. ten years later. His academic achievements also include a Doctor of Science degree in electronic systems from 1987. Professor Kulemin has been an assistant professor and senior lecturer on the Electronic Systems Faculty of the Kharkov Aviation Institute. Since 1966, he has worked at the Institute of Radiophysics and Electronics of the Ukrainian National Academy of Science. Currently, he is a principal scientist in the Millimeter Radar Department and a Professor at Kharkov Military University. It is well worth mentioning that Professor Yakov Shirman, the author of Computer Simulation of Aerial Target Backscattering, Recognition, Detection and Tracking (Artech House 2002, reviewed in Systems Magazine, No. 11, 2002) works in Kharkov. Professor Kulemin’s main research interests include radio signal backscattering from targets and their environment, radar remote sensing, and millimeter-wave radar systems. As becomes evident when reading Kulemin’s text, he has been deeply involved both in the theoretical and practical aspects of these research fields. Before this book, Professor Kulemin had already authored in Russian about similar topics and has written more than 200 scientific publications. In addition to his Ukrainian and former Soviet-era appointments, Professor Kulemin is also a member of URSI and IEEE.

The book’s style is a nice balance between theory and experiments. This is also indicated by the numbers; there are
about 380 equations but also more than 130 illustrations and almost 100 tables full of real-world data. Readers need not worry about mathematical complications because Professor Kulemin has kindly given most of the mandatory algebra in a pre-processed form, (e.g., integral equations have been mostly solved whenever practical). Many of the equations are plotted together with experimental data, which seems very suitable for educational purposes, as well. Chapter 4 has the highest relative portion of calculus, which is not surprising when the topic is sea clutter. Professor Kulemin has listed about 300 references "for further reading." However, as the publisher's current style requires reference listing after each main chapter, a good deal of overlapping or redundancy is probably there. Around thirty percent of the reference publications are indicated as original documents in Russian, which might complicate deeper research. Another feature is the amount of 1960s material, which is obviously presented to western readers for the first time.

It seems that the author has aimed at a technically and scientifically solid entity and, for the most part, he has succeeded very well. Especially those sections which describe work and experiments performed by Kulemin, himself, or by his own team, contain in-depth material and useful data, some of which has presumably appeared earlier in Russian journals or books but is not known to most Western readers. For example, the description of real measurements of explosions and jet engine exhaust fumes is interesting to read. Similarly, Professor Kulemin's research on ground-to-ground millimeter-wave radar looks comprehensive. Another attractive feature of this book is the inclusion of "final remarks" toward the end of each section or chapter. This makes it much easier for the reader to rapidly acquire an overview of those parts of the book where his/her main interest might be. In this sense, any "Table of Contents" would fail as the titles seldom tell enough about what is to come.

Any of us in defense-oriented radar research would face the problem of classified or confidential data. This could have been the reason why Professor Kulemin's book does not include very much results or experiments surely performed, e.g., in Kharkov during the past five to ten years. Therefore, despite the fact that Western readers may well see many of the graphs and tables for the first time, they are, in general, not very new. Actually, I can recall that I met two of the radar target examples of this book during my summer vacation. The GAZ-63 truck was in an historical car museum – not too far away from one of the world's few remaining 1930s Mercedes convertibles – and the MiG-21 in the Finnish Aviation Museum. But, using declassified or "safe" material is understandable and acceptable. We all have to live with it. In order to make a comprehensive and balanced book, the author has included lots of results that have appeared in various IEEE journals and conferences. Also, material from major US publishers has been used. This is a bit problematic. Of course, the reader now avoids hunting missing details, e.g., in Barton's system volumes or Currie's clutter book, but, at the same time, a more experienced colleague might be annoyed by frequent citations of rather well-known findings. A final remark related to material concerns some measurement results which seem to describe S-, C-, or X-band experiments only. It is indeed fine to show comparisons of RCS behavior of typical targets at different frequencies, but it looked to me that, in some cases, real millimeter-wave data was not shown at all, maybe that was not available.

There is no List of Symbols in this book. I could not find a List of Abbreviations and Acronyms either. This is a serious drawback. Particularly the amount of useful mathematics in Professor Kulemin's book would have deserved a symbol listing. Unfortunately, this is not the first (and surely not the last) time I find such negligence. If the author does not initially provide necessary material, the publisher of scientific and technical books should require it. Some minor details might also have deserved more attention during the final phases of the editorial process. My own ability to write English is far from fluent and the editorial people used by famous publishers surely have perfect command of the language. Anyhow, I still found occasionally that the style of sentences closely resembled the one I used to hear as a DX-listener in Radio Moscow's Finnish transmissions in the late 1960s. Somehow, thinking stays in Russian despite the fact that the text is correctly translated into any other language. One or two equations that I tried myself did not match the respective plot given in a close-by illustration. It remains a mystery if the fault was in the figure or was something wrong in the mathematics. Or maybe my calculator went crazy!

My overall view of Millimeter-Wave Radar Targets and Clutter is surely positive although slightly confused. Maybe I was childishly wanting too much and yet, the compilation created by Professor Kulemin is very good and attractive. The text is easy to follow and a careful reader may well feel the expertise of an experienced and mature scientist and the flavor of several decades of patriotic and patient work. Illustrations and graphs are clear, their content is understandable and generally relevant to the topic. Connections to the real world are made as often and as thoroughly as allowed by available data and the limits of national security. In my opinion, we have to evaluate Professor Kulemin's book as an entity and give appropriate appreciation to the value of getting plenty of data and results in book form — and in English. I think many of our Systems Magazine readers and colleagues in radar research will find Millimeter-Wave Radar Targets and Clutter interesting. The text is also suitable for university courses, maybe starting from the third spring semester.

—Reviewed by Pekka Eskelinen
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<td><a href="mailto:Eli_Brookner@raytheon.com">Eli_Brookner@raytheon.com</a></td>
</tr>
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<td></td>
<td></td>
<td>(301) 774-4607 V&amp;F</td>
</tr>
<tr>
<td>Radar — Past, Present and Future</td>
<td>Dr. Eli Brookner, Raytheon</td>
<td><a href="mailto:s.durrani@ieee.org">s.durrani@ieee.org</a></td>
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<td></td>
<td>+44-20-7679-7310</td>
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<td>+44-20-7358-7325 F</td>
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<tr>
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<td><a href="mailto:h.griffiths@ee.ucl.ac.uk">h.griffiths@ee.ucl.ac.uk</a></td>
</tr>
<tr>
<td>Satellite Communication Systems</td>
<td>Dr. S. H. Durrani, Consulting Engineer</td>
<td>(206) 954-9616</td>
</tr>
<tr>
<td>Synthetic Aperture Radar</td>
<td>Dr. Hugh D. Griffiths, University College, London</td>
<td>(860) 486-4823</td>
</tr>
<tr>
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<td>(860) 486-5585 F</td>
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<tr>
<td>System Engineering for International Development</td>
<td>Paul Gartz, Boeing Co.</td>
<td>+972-4-829-3196</td>
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<td>+972-4-823-1488 F</td>
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<tr>
<td>Target Tracking and Data Fusion: How to Get the Most Out of Your Sensors</td>
<td>Dr. Yaakov Bar-Shalom, Univ. of Connecticut</td>
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<tr>
<td>The Evolution of Inertial Navigation</td>
<td>Dr. Itzhak Bar-Itzhak</td>
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All data on this page is under the purview of Walter D. Downing, VP-Member Affairs. Please send all corrections and omissions to him at the address on the inside back cover.
FROM THE EDITOR-IN-CHIEF

IEEE Virus Blocking; IEEE Membership Criteria

The IEEE E-mail Alias Service protected members and staff from more than 1.8M viruses in 2003. Last year, 14,723 new IEEE e-mail aliases were created, bringing the total to 93,157. The IEEE Personal Email Alias also offers an optional anti-spam feature – the Unsolicited Commercial E-mail (UCE) filter.

Evelyn H. Hirt

Choose your level of filter sensitivity; have UCE tagged for your review or blocked from delivery. Members can sign up for these free services at: http://eleccomm.ieee.org/.

IEEE Membership: I have just returned from the February 2004 IEEE Organizational Unit Series in Savannah, Georgia. At the BoD meeting, there was an interesting presentation and discussion on membership. We learned the current qualifications for membership, in general, and member grades, in particular. You might be surprised at the broad range of disciplines that qualify for Member grade in IEEE and current advancement criteria for Senior Members and Fellow grades. If you know someone who could benefit from what IEEE and/or AESS has to offer; check the latest member qualifications at: http://www.ieee.org/portal/index.jsp?pageID=corp_level1&path=membership&file=understanding.xml&sxl-generic.xsl#Member.

If you are planning for retirement, check the criteria and benefits of Life Member accessible from that site. IEEE has established three special circumstance member categories: http://www.ieee.org/portal/index.jsp?pageID=corp_level1&path=membership&file=dues.xml&sxl-generic.xsl for when economic circumstances impact members’ ability to pay dues.

If you have questions about AESS membership, contact Walter Downing, AESS Vice President-Member Affairs.

– Evelyn Hirt

AESS Members Honored

Inventors Hall of Fame

Life Fellows Bradford Parkinson and Ivan Getting (deceased) will be inducted into the US National Inventors Hall of Fame on May 1, 2004 (as part of a class of 20) for their work that “exemplifies the tenacity and enthusiasm that is the inventive spirit.” (More on: www.invent.org.)

Laureates

Aviation Week & Space Technology Magazine has named James Ward and Eli Brookner, individually, and the team of William M. Brown, William R. Boario, and Jack Walker, as Laureates for 2003 in the category of electronics. They will be awarded their Laureate Trophy at the National Air & Space Museum on April 6, and their accomplishments will be recounted in the April 19, 2004 issue. (See AWST, February 2, 2004; or www.AviationNow.com/awst.)

Fred Nathanson Memorial Radar Award

This award, sponsored by the IEEE AESS, was established to grant recognition for outstanding contributions to the radar art by a member of AESS who has not exceeded age 40 in the year nominated.

For 2004, this award, consisting of a plaque and an honorarium, was presented to Fulvio Gini, Associate Professor, University of Pisa, Pisa, Italy. [Dr. Gini’s biography may be found in IEEE Transactions on Aerospace and Electronic Systems, 39, 4 (October 2003), 1351.]
IEEE AEROSPACE & ELECTRONIC SYSTEMS SOCIETY ORGANIZATION

IEEE/AESS Website: http://www.ewh.ieee.org/aess

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Panels & Committee Chairs report to officers of AESS as noted in parenthesis.
UWBST 2003: A Successful Meeting

The Second Ultra Wideband Systems and Technologies (UWBST) Conference, held in Reston, Virginia, USA, November 16-19, 2003, was a great success. Hosted by Virginia Tech’s (VPISU) Mobile and Portable Radio Research Group (MPRG), the IEEE sponsors were the Microwave Theory & Techniques Society and the Northern Virginia Section.

General Chair was Jeff Reed and the Technical Chair was Mike Buehrer, with Jenny Frank serving as overall coordinator. The technical program consisted of 74 papers and 23 poster presentations. DARPA’s NETEX held a separate session which included 5 invited papers. Attendance was 213, with tutorials on Ultra-Wideband Communications: A Technology Whose Time Has Come and Ultra Wideband Technology for Wireless Personal Area Networks — The IEEE 802.15.3/3a Standards attracting an audience of 60. The Plenary talk, An Introduction to Ultra-Wideband Antennas, was presented by Dr. Hans Schantz. [See page 22, this issue -Ed.]

The Student Paper Award went to Claudio R.C.M. da Silva of the University of California San Diego for Spectral-Encoded UWB Communication Systems.

UWBST 2004 will be held in Kyoto, Japan, May 18-21, 2004. 2003’s contacts are:


Call for Nominations

IEEE Dennis J. Picard Medal
for
Radar Technologies and Applications
Sponsored by the Raytheon Company

The IEEE Dennis J. Picard Medal for Radar Technologies and Applications was established in 1999 for outstanding accomplishments in advancing the fields of radar technologies to an individual or group of up to three. Recipient selection is administered by the IEEE Awards Board through its Medals Council. A Picard Medal Evaluation Committee, consisting of representatives from the Aerospace and Electronics Systems Society, Antennas and Propagation Society, Circuits and Systems Society, Electron Devices Society, Geoscience and Remote Sensing Society, Microwave Theory and Techniques Society, Signal Processing Society and Ultrasonics, Ferroelectrics, and Frequency Control Society, reviews nominations and forwards a recommendation to the Medals Council. Criteria considered by the Evaluation Committee include leadership in the field of radar technologies and applications; originality, breadth, inventive value and duration of individual and/or group contributions; publications and patents; society activities and awards; industry recognition and honors; and nomination quality. The award consists of a gold medal, certificate, and cash prize.

Information on the Medal and the nominations forms may be found at:

Nomination Deadline: 1 July 2004

The conference is organized in the framework of international relations set up between the Institution of Electrical Engineers, the Institute of Electrical and Electronics Engineers, the Chinese Institute of Electronics, the “Verband Deutscher Elektrotechniker,” the Institut Français de Navigation, the Institution of Engineers Australia (IEAust) and SEE.

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The conference will focus on new research and developments in the field of radar techniques for both military and civil applications, including: Environment & Phenomenology; Systems; Remote Sensing from Airborne or Space-borne Systems; Waveform Design, Beamforming, and Signal Processing; Emerging Applications; Emerging Technologies; Advanced Subsystems Technologies; Computer Modeling & Simulation; Management Techniques; and Automatic Classification.

Tutorials will be held prior to the conference.

SEE: (Congres@see.asso.fr) or (marc.lesturie@onera.fr)
RADAR 2004 – SEE, 17 rue Hamelin, 75783, Paris CEDEX 16 (France)
Tel: +33 1 56 90 37 05; Fax: +33 1 56 90 37 19
IEEE AUTOTESTCON is the world’s only conference that focuses primarily on Automated Test and related technology for military, government and aerospace applications. Over its 35+ year existence it has grown into the premier annual conference for this application field. The conference also has an expanded focus into commercial areas that share a common technical base, including aerospace, vehicle and automotive, and commercial factory test applications.

AUTOTESTCON is a comprehensive technical conference that provides an open forum for leaders in design, development, procurement, applications and operations to exchange information relative to their specific needs and disciplines concerning automated and computer-controlled test systems and software. Heavy focus is given to manufacturing and maintenance testing environments. In addition to the comprehensive Technical Program, there is a full suite of directly related exhibits that provide significant enhancement to the technical focus.

AUTOTESTCON also hosts a Seminars Program that provides a number of courses in the Automatic Test field, covering hardware, software, and Test Program Set topics of interest.

Today’s demanding test environments require the most up-to-date hardware and software. Come to AUTOTESTCON in San Antonio, TX and see it all in one place!
1. NAME AS IT SHOULD APPEAR ON IEEE MAILINGS: SEND MAIL TO: | Home Address OR | Business/School Address
PLEASE PRINT. Do not exceed 40 characters or spaces per line. Abbreviate as needed. Please circle your last/surname as a key identifier for the IEEE database.

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<th>TITLE</th>
<th>FIRST OR GIVEN NAME</th>
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2. Are you now or were you ever a member of IEEE? | Yes | No | |
If yes, please provide, if known: MEMBERSHIP NUMBER | |

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<th>Grade</th>
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DEMOGRAPHIC INFORMATION — ALL APPLICANTS —

Date of Birth | Male | Female |
Day | Month | Year |
|        |      |      |

3. BUSINESS / PROFESSIONAL INFORMATION

Company Name |

Department / Division |

Title / Position | Years in Current Position |
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Years in the Profession Since Graduation | PE | State / Province |
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4. EDUCATION A baccalaureate degree from an IEEE reference list of programs assures assignment of "Member" grade. For others, additional information and references may be necessary for grade assignment.

Baccalaureate Degree Received | Program / Course of Study |
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Highest Technical Degree Received | Program / Course of Study |
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5. SIGNATURE OF APPLICANT

I hereby make application for IEEE membership and agree to be governed by IEEE’s Constitution, Bylaws, Statements of Policies and Procedures, and Code of Ethics.

Full signature of applicant | Date |
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6. CONTACT INFORMATION

Office Phone | Home Phone |
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7. 2004 IEEE MEMBER RATES

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*IEEE Canadian Business No. 1256341988
**IEEE membership required or requested for online access to Ref/Pub.

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Transactions on:

Aerospace and Electronic Systems | Print | $25.00

Pattern Analysis and Machine Intelligence | Print | $44.00

Electronic | $35.00

Comb-Print and Electronic | $67.00

Journal of Lightwave, Technology, IEEE/OSA | $35.00

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Canadian residents pay 7% GST or 15% HST on Society fees only. Reg. No. 1256341988

TAX | $ |

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IEEE A&ES SYSTEMS MAGAZINE, APRIL 2004