Aardvark Newsletter

August 2012

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Our Sponsors

LITTLE CROW CONFERENCES

We have 2 Little Crow Conferences coming up on:

- 5 September 2012 @ SAAB EDS, Centurion.
- 7 November 2012 @ the CSIR, Pretoria.

Little Crow Conference 5th Sept 2012

There is just one more week to register for our second Little Crow EW conference on the 5th of September 2012 before registration closes on Friday the 31st of August. Please take the effort to register and attend the half day conference – it is an ideal opportunity to find out more about some of the new developments and thoughts in our EW industry and to interact with others in the EW community – so don't miss it!

As is our custom with mini conferences, attendance is free but in order to do proper planning, register with salome.warriker@za.saabgroup.com ,

fax 012 6726098 or telephone 012 6726255.

Venue: Saab Support & Services facility in the Highveld Techno Park Centurion

Program

12h30 – 13h00	Registration	All
13h00 – 13h20	Welcome & Opening	Harry Schultz & Gerrie Radloff
13h20 – 14h00	Sensors and Countermeasures: An updated Armscor perspective	Lewis Mathieson, Armscor
14h00 – 14h40	The implementation of Digital Receiver technology in the latest version Emitter Location System	Andrew Gray, Saab EDS
14h40 – 15h00	Break	All
15h00 – 15h40	Laser Influence on Infrared Sensors: A Background Study	Hannes Calitz, CSIR
15h40 – 16h20	Laser Warning for Self Protection	Ludi Kruger, SAAB EDS
16h20 – 16h40	Closing address	Gerrie Radloff
16h40 – 19h00	Informal function and networking	All

SPONSORS

We would like to welcome Peralex as the newest sponsor of the Aardvark Roost.

You are invited to visit their website (http://www.peralex.com) to find out more about this company.

Peralex started in 1987 when three young engineers decided to pool their talents and challenge the market which was dominated by 'big company' electronics engineering. At the time, technology was emerging that allowed signal processing theories to be implemented in real-time using a new class of Digital Signal Processing microprocessors.

Peralex was launched and used its expertise to design new products that could replace existing traditional analogue circuitry. Not only did these new products outperform the old technology in terms of flexibility, repeatability, reliability and performance, but they opened an exciting new market.

Peralex produces high performance wideband radio receivers, analogue to digital converter boards, DSP based processor boards, and signal processing and analysis software to drive this hardware. Together with products from their partners, these are combined to create wideband radio spectrum surveillance, direction finding, and signal analysis equipment.

They also design and create sonar signal processing hardware and software for use in mining, prospecting and other applications, and audio signal processing systems.

CONTRIBUTIONS

This newsletter will be sent out roughly on a monthly basis to the South African EW interest group (currently more than 340 people). If you want to contribute with any article/news, please feel free to send it to Christo Cloete (ccloete@csir.co.za) for inclusion in the next newsletter. Also, if you know of people interested in EW that are currently not on the distribution list, please will you send Christo their contact details.

INDUSTRY NEWS

Brazil, India and South Africa want to develop joint projects in the area of defense

Representatives of the IBSA countries (India, Brazil and South Africa) recently met in Brazil to continue discussions on cooperation in the area of defense. The first meeting which took place in Brasilia, brought together officials from 22 ministries and representatives of national defense industries. "Our intention is to seek ways of interaction and partnership," said Aderico Mattioli, director of the Department of Defense Products MD Brazil. The visit to Brazil is the second in a series of three – the first visit was to India and the visit to South Africa is planned for November. These visits aim to identify the relevant industries in each country and explore opportunities for cooperation and joint projects. Antonie Visser, Chief of Defence Materiel Division of the South African delegation, agrees. "The purpose here is not to compete, but cooperate in research and development in the medium and long term". During the meeting in Brasilia, foreign representatives were introduced to the organizational structure of Ministry of Defense, its defense systems and current projects. Also present at the meeting were representatives of the Brazilian Association of Manufacturers of Materials for Defense and Security (ABIMDE). Pramode Kumar Mishra, the Assistant Secretary of Government of India, commented that "The three countries have the same vision for the world and are pursuing a common goal of developing technologies that together can meet the expectations of the group. Representatives from India and South Africa will visit military research and development units a well as institutes and defense industries such as Emgepron in Rio de Janeiro, Embraer and Avibras in Sao Jose dos Campos (SP).

Africa Aerospace and Defence (AAD 2012) returns to the City of Tshwane

The City of Tshwane will see the return of Africa 's largest exhibition of air, sea and land capability at AAD 2012 at AFB Waterkloof. From 19 to 21 September 2012, trade and static displays will attract trade visitors from more than 28 countries, followed by airshows on 22 and 23 September 2012 that will be open to members of the public. It's expected that the open days will attract a crowd of over 60,000 per day.

The trade days will feature 12 National Pavilions from India , Russia , Turkey , Italy , Germany , Belgium , China , USA , UK , Romania , Pakistan and Brazil and are expected to stimulate business for local and international companies involved in the growing defence, general aviation and security industries. AAD 2012 opens doors for local manufacturers and the huge amount of interest from the international defence and aerospace industry creates opportunities to exploit emerging markets in the Southern African region as well as the continent as a whole.

There will also be a youth development programme, where youngsters (learners and students) can experience the world of flight simulators, vehicle simulators and model building. Industry representatives will be on hand to provide more information about careers in the aerospace and defence industries.

CSIR DPSS

Target recognition with radar gets smarter

R&D performed at the CSIR over the past five years as part of its AwareNet programme, confirms that exciting trends in several aerospace and remote sensing technologies allow new concepts for persistent and ubiquitous surveillance to be turned into realisable innovations by the South African aerospace industry.

One of the areas of research was radar target classification using inverse synthetic aperture radar (ISAR) techniques. ISAR is a radar processing technique used to generate a target image from which at least the class of target, and in some cases even its identity, may be estimated, even at long ranges and under conditions of bad visibility. Most published ISAR imaging algorithms are based on the assumptions that the target is rotating around a fixed axis of rotation and at a constant angular rate. However, the motion of small boats in rough seas violates both these assumptions most of the time, leading to significant distortion and/or blurring in the resulting ISAR images.

CSIR research focused on understanding the effects that cause blurring, both through theoretical analyses and practical measurements. This resulted in important insights into the limitations of published ISAR algorithms and how these may be overcome. It is expected that this work will contribute significantly to the target classification function of the AwareNet radar sensor. In the mean time, some of the mathematical models and simulations as well as the measurement techniques developed are already finding application in a number of other South African radar R&D projects.

Field trial data aid research on radar detection

In the quest to develop a surveillance system to assist South Africa in curbing weapons trafficking, smuggling, poaching, piracy, illegal immigration and terrorism, CSIR researchers undertook a series of radar measurement field trials, using its various home-grown measurement facilities.

For the development of a persistent, ubiquitous surveillance system that will provide unprecedented situational awareness, it is crucial to verify initial modelling and simulation results with actual measured data - hence the field trials.

While entities of interest range from small recreational watercraft to large cargo and tanker ships, significant research effort was directed at the detection of small boats, which is particularly difficult due to the often comparable magnitude of the boat and sea surface radar return (the small boats are often shadowed by the sea waves).

The project continues, with researchers attempting to model the radar reflectivity characteristics of sea waves under all environmental conditions, as well as reflectivity characteristics of different classes of small vessels in the South African maritime area. The shared dataset from these trials are proving to be invaluable to the international network of research aimed at developing different detection and tracking techniques.

Radar technology touted as best world-wide

Currently, the largest defence acquisition programme for the South African National Defence Force is the Ground Based Air Defence System. A key element of this system is its radar. Armscor has the option to import this radar or to use a radar developed and manufactured in South Africa. It was decided that a local radar will only be considered if it is internationally competitive on both price and performance.

In response to this, the second phase of what was probably the largest collaborative radar technology development project ever undertaken in South Africa, the DBR-XL Radar Technology Development Programme, has been successfully concluded. It has been described by defence stakeholders as superior to all international offerings and suitable as a missile fire control radar for the current, and future, model of the Umkhonto missile.

The CSIR provided independent evaluation of the technical concepts based on previous radar experience and detailed radar and algorithm level modelling and simulation; developing optimised signal processing algorithms;

participating in missile fire control system level performance analysis workshops and providing specialist input based on its advanced radar signal processor design and development experience.

Collaborators included the CSIR, Armscor, the universities of Cape Town and Stellenbosch, industry stakeholders such as Reutech Radar Systems, Denel Dynamics and Denel Integrated Systems Solutions, and the Ground Based Air Defence System Programme Office.

This development is expected to lead to further development of the local radar industry as well as export opportunities.

Simulation environment for electronic warfare sharpens decision-making

The CSIR's sensors and electronic warfare engagement simulation (SEWES) is used by defence research institutes for evaluating the effectiveness of electronic warfare, developing doctrine and training.

SEWES is a 'few-on-few' simulation environment allowing for any number of platforms populated with various sensors and systems to engage each other.

During the financial year, the CSIR expanded on its SEWES modelling and simulation capability by adding airborne sensor and electronic warfare system models to assist in the evaluation of the effect of electronic warfare on the Gripen fighter aircraft. Closer integration between hardware systems, such as the DRFMs and MecORT have resulted in a mixed real/virtual test bench for radars.

Decision makers typically use SEWES to simulate "what if" questions. To maximise platform survivability, the use of sensors and electronic warfare systems can be optimised given a threat scenario. These vary from algorithm level questions such as the range at which the signal intercept system will be effective, to doctrine type questions such as how the countermeasure system could be utilised to optimally protect a platform.

A typical tactical engagement investigation would be to evaluate the sensor and electronic warfare system coverage of a fighter aircraft, given that the coverage would be limited due to system performance, the terrain, and the flight path of the aircraft.

On a more detailed level, the performance of these systems can be predicted given the dynamic nature of the engagement and the effects of the natural terrain. At this level a typical question would be to investigate at what range a small target, such as an inflatable boat, could be detected in a piracy scenario.

The parameter level simulation of the systems and interactions are modelled to a level as required by the research question. All required system parameters in the simulation are stored and visualised in a realistic 3D world.

CSIR demonstrates system of systems capability

In brief

In order to demonstrate its ability to integrate complex systems, the CSIR has integrated the Electronic Warfare Engagement Simulation (SEWES) with its Digital Radio Frequency Memory (DRFM) and SigmaHat, the organisation's new Radar Cross Section (RCS) prediction tool. Each of these has been in development for some years, and progress over the past year has demonstrated that complex systems can be successfully integrated at minimal cost.

The challenge

The challenge was to create a more accurate hardware in the loop (HWIL) simulator by integrating three independent simulators, all of with minimal effort.

CSIR research

During the past financial year, the CSIR completed its integration of SEWES with the DRFM and SigmaHat, the organisation's new RCS prediction tool.

SEWES is a few-on-few electronic warfare simulation environment with the capability to create, perform and analyse scenarios. This facilitates trade-off studies ranging from algorithm level research to doctrine development

and evaluation. It is a scalable simulation that allows for a wide range of platforms and entities, consisting of various sensors or effectors, to engage each other in a simulated realistic virtual environment. Simulated 'what if' scenarios can be displayed, stored and evaluated while the engagement is visualised in 3D. The more scenarios that can be run, the better prepared we are for any eventuality.

SEWES' innovative architecture allows it to adapt itself to each scenario's unique requirements and to interoperate with other simulators. Naval, air or ground platforms can be selected; each having its own command and control, and from where all interactions between systems are controlled and time-line behaviour observed. It also allows for faster than real-time simulations, making HWIL testing possible. Models can be modified or added as and when new scenarios present themselves.

The user is offered the freedom to import validated real world parameters, be it positional data, RCS, infrared signature or measured antenna patterns. Generated outputs are export- ready and compatible with other applications, such as 3D display and visualisation tools. SigmaHat is a radar scattering prediction tool for large complex objects. It can provide estimates of the RCS of naval, air or ground platforms. In the integrated setup, platform- profile information from SEWES can be used by SigmaHat to calculate the RCS for all target aspect angles in a profile.

The RCS data is then used to extract dominant scattering points of the platform for each frame in the profile. The parameters of these scattering points are exported to SEWES, which integrates the data into the scenario simulation. SigmaHat's real beam image shows the distribution of the platform's scattered field intensity, indicated as varying colour profiles. SigmaHat is based on innovative calculation techniques which provide a blend of scale, speed and accuracy, perfectly suited to radar and electronic warfare (EW) applications. The DRFM is the hardware closing the loop with the radar under test that responds in real-time to radar signals. The DRFM records pulses received from the radar system, and then plays the recorded pulses back towards the radar, which now perceives these pulses as reflections from a target.

Traditionally, DRFMs simulate targets as single point reflections with only one pulse played back per target. The latest module simulates targets as a collection of point scatterers. It is essentially multiple DRFMs in one. This DRFM illustrates the depth of the CSIR's expertise in high-speed mixed signal hardware, and firmware and digital signal processing. This integration of the DRFM with two software simulators – SEWES and SigmaHat – provides a high-fidelity hardware in the loop environment for radar and EW research and development, such as target classification and deception jamming. It can also assist with personnel training. It is a virtual environment that allows scenarios to be played out in the real world in real time.

Outputs

The outputs were:

A successful demonstration of the integrated hardware and software which was mobile, and could be shown locally and internationally.

A video to capture the integrative effort, as well as to showcase the three simulators in separation and how they can be combined to form a superior simulator.

Software and firmware generated to enable integration currently, and in the future.

Outcomes

Apart from the knowledge generated, the CSIR team realised that integrating complex systems is possible with minimal resources, and the result of such an integration can be a marketable offering. It demonstrated a multidisciplinary integration capability, confirming that the CSIR can integrate systems of high complexity and performance.