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IEP AD 01: Structural Test System Modelling

Location: Fishermans Bend, Victoria
Project Description:
Drawing from your academic understanding in the fields of applied physics, electro-mechanical, computing, control systems and instrumentation, you will develop simulation model of a simple structural test system and validate its static and dynamic operating characteristics via the implementation of the real-time test system platform.
Project Objectives:
1. Explore capability to 'approximate and validate' the model and simulated test scenarios of a typical structural test system within the modelling domain. 2. Interface of dynamic real-time 'physical' control system to its mathematical model via the implementation of a real-time test platform. 3. Moving away from the traditional expensive 'trial and error' hardware setup to demonstrate feasibility and cost effectiveness in utilising test system modelling that potentially enables us to meet structural test objectives with a greater degree of certainty.
Project Activities:
1. Develop a Matlab Simulink model of a simple test configuration, for example a cantilever beam being loaded by a single electromechanical or servo-hydraulic actuator. 2. Establish and quantify the real-time interface between MTS control execution and loop and Matlab Simulink application and using ScamNet network. 3. Implementation of a real-time control and data acquisition instrumented test system for structural test modelling in real-time, demonstrated with measured data. 4. Iteratively refine the Matlab Simulink model to achieve 'best matching' of structural test system's physical characteristic and response under various test scenarios. 5. Final placement presentation.

IEP AD 02: 3D shape and topological optimisation for repair of aircraft structures

Location: Fishermans Bend, Victoria

Project Description:

The IEP project is to contribute to a Science Team's effort that aims to further enhance its shape and topological optimisation capability for the repair of aircraft structures. The applicant can choose one of the following two sub-projects:

1) Develop an enhanced approach for efficient design of complex 3D optimal rework shape for blending repair of cracked aircraft structures. The enhancement is needed in recent experience has shown the design to be time consuming, mainly due to manual input needed to create high quality FE models from CAD and 3D scan data.

2) Instigate the emerging structural design strategies which are unique for additive manufacturable components in the context of define applications. This activity was initiated in the context that additive manufacturing has become increasingly mature, allowing practical applications of topologically and shape optimised structural designs for aircraft components.

Whichever sub-project is chosen, the successful applicant will work in a science team that has extensive experience in research, development, application of structural shape optimisation.

Project Objectives:

Sub-project 1: To contribute to the science team's effort that aims to establish approaches for a more efficient design of 3D optimal rework shape. This includes enhancement of the geometrical description and iterative finite element analysis for design of optimal shape.

Sub-project 2: The objectives include; (i) enhanced understanding of the latest development on research and application of topologically and shape optimised structural designs for additive manufacturing; (ii) design, manufacturing and assessment of a topologically and shape optimised replacement for a typical aircraft component.

Project Activities:

1. Reviewing existing work on shape and topological structural optimisation relevant to the purpose of this project;

2. Using DST Group's shape optimisation code and commercial FE software to design optimised rework shapes for typical aircraft components;

3. Evaluating the functionalities of commercial code for structural shape/topological optimisation;

4. Manufacturing and assessing of optimal design; and

5. Documentation and final presentation.

Relevant Research Areas and Desirable Skills:

- A degree in mechanical, aerospace or civil engineering; and
- Experience with structural mechanics and finite element analysis.

IEP AD 03: Advanced Composite Materials Structural Modelling and Testing

Location: Fishermans Bend, Victoria

Project Description:

Delamination and growth of advanced composite materials in aerospace applications is currently managed using conservative design principles. The aim of the current project is to develop representative coupons for fastened composition and examine conditions under which damage evolves and grows under fatigue loading. Damage analysis will be correlated with advanced FEA models.

Project Objectives:

1. Develop a representative composite coupon to analyse damage evolution and growth.
2. Undertake fatigue testing of the coupons to establish conditions for growth in the presence of known damage levels.
3. Characterise the damage in the coupon and correlate to existing FEA models.

Project Activities:

1. Assist in development of representative composite coupon;
2. Assist in the manufacture of the composite coupon and fastener hole machining;
3. Assist in the mechanical testing of the fastened coupon;
4. Introduce representative damage into the coupon;
5. Establish conditions under which damage will grow in the coupon under fatigue loading;
6. Characterise the nature of damage growth in the growth coupon after damage is introduced; and
7. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Practical experience in a test-lab environment is highly desired; and
- Research areas include materials engineering and/or mechanical engineering.

IEP AD 04: Autonomous Diagnostic Thermal Imaging for High Performance Engineering Structures

Location: Fishermans Bend, Victoria

Project Description:

The position is located within the Airframe Diagnostics Systems group in the Aerospace Division, Fishermans Bend, Melbourne, VIC. The successful applicant will contribute to the development and testing of a new technology for autonomous diagnostic thermal imaging of a high performance airframe structures using miniature infrared microbolometer cores. It represents the next generation of the MiTE system, a breakthrough developed by the Defence Science and Technology Group and successfully applied to all three variants of the Joint Strike Fighter aircraft, the most advanced fifth generation fighter in the world. As part of an ongoing effort to broaden the awareness of this powerful full-field diagnostic technique, DST Group has created a freeware version that can be downloaded from its public web site at http://www.dsto.defence.gov.au/opportunity/mite.

Interested applicants can find relevant information about its capability at this site.

The role will involve assisting DST staff in a laboratory evaluation of the next generation of this technology. The successful applicant will work with miniature microbolometer thermal imaging cores, MEMS accelerometers, laser displacement sensors, wireless communications and be exposed to a range of concepts in image and signal processing, structural and thermal finite modelling, and fatigue and structural mechanics. The tasks will include experimental investigation of system performance, designing and developing hardware packaging solutions and using C++, Matlab and COMSOL based computational tools to develop insights into system performance. The successful applicant will have opportunities to publish and present their work.

Project Objectives:

1. Design, develop and conduct experimental testing of the new stress-imaging technology;
2. Acquire, collate, analyse and interpret experimental data using various techniques;
3. Design and produce 3D laser printed hardware packaging porotypes; and
4. Contribute to scientific publications.

Project Activities:

1. Mid-year report;
2. Final report; and
3. Final placement interview and presentation.

Relevant Research Areas and Desirable Skills:

- Mechanical Engineering;
- Materials Science;
- Engineering;
- Physics;
- Mathematics;
- Software Development; and
- Electronical Engineering.

IEP AD 05: Contribute to Defence Forensic Engineering Incident Investigations

Location: Fishermans Bend, Victoria

Project Description:

The position is a unique opportunity to be a part of DST Group's Forensic Engineering, working with a number of Engineers and Scientists in priority incident investigations associated with Royal Australian Air Force aircraft components and systems. Throughout this placement, a broad range of laboratory and forensic skills will be developed covering many aspects of an aircraft investigation, including contributing to preliminary investigation reports and assisting in writing final factual reports.

Project Objectives:

1. To develop forensic laboratory skills required for the investigation;

2. To undertake the complex forensic investigation of the ADF components as a team member, and through development of skills necessary to work under guidance and limited supervision; and

3. To present the forensic findings to the Client, in the form of a DST Client report.

Project Activities:

1. Assist Forensic investigators covering various laboratory disciplines;

2. Conduct relevant research to contribute to findings;

3. Present preliminary findings to principal investigators;

4. Contribute to writing of final reports; and

5. Final placement interview and presentation.

Relevant Research Areas and Desirable Skills:

- Materials Engineering;
- Ability to show initiative and sound judgement in problem solving;
- Good communication and interpersonal skills; and
- Self-motivated and task focussed.

IEP AD 06: Data development for probabilistic risk analysis of FA-18 airframe components

Location: Fishermans Bend, Victoria

Project Description:

With the annual fatigue assessment indicating that the RAAF F18 fleet is accruing fatigue damage rate higher than initially certified, DGTA has expressed interest in probabilistic risk analyses of FA-18 airframe components. With the methods and tools having been developed over the last few years, the quality of the analyses would mainly depend on of the quality of the input, especially the possibility of distribution of initial flaws, and load spectra. Previous work on the development of EIFS or EPS distribution used in a Lognormal Distribution model which has infinite right tail and is unrealistic since airframe components have finite dimensions. In probabilistic structural integrity assessment, the analysis is heavily dependent on the right tail of the EIFS distribution. Thus a bound distribution model (e.g., Beta distribution) is more suitable. The stress exceedance curves are also a critical data in the analysis. The stress exceedance curves to be used in the risk analysis have never been developed. Developing this data needs a considerable amount of time since the work will involve extractingFT-46 test data for various locations to be analysed.

Project Objectives:

To develop the input data ready to use in the risk analysis tool FracRisk. This includes;

(i) A bounded distribution (e.g. Beta distribution) model for the F-18 EIFS data; and

(ii) Stress exceedance distribution curves for difference F-18 locations.

Project Activities:

1. Collecting EIFS or EPS of FA-18 test data from DST Group reports;
2. Compilation of FT-46 load stresses for different locations;
3. Statistical analysis of EIPS/EPS data;
4. Statistical analysis of stress exceedances for various FA-18 locations;
5. Development of EIFS distribution using Beta distribution model; and
6. Development of stress exceedance curves for various locations of FA-18;
7. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Mathematics and statistics; and
- High academic results whilst studying undergraduate degree are desirable.

IEP AD 07: Development of laser-based interrogation system for high speed response measurement of fibre Bragg gratings to characterise acoustic waves

Location: Fishermans Bend, Victoria : Edinburgh, South Australia

Project Description:

He position is located within the Airframe Diagnostics Systems group in the Aerospace Division, Fishermans Bend, Melbourne. The successful applicant will be an integral member of a small multi-disciplinary team working towards the development of a new optical interrogation system to measure the instantons response from a network of optical Fibre Bragg Gratings (FBGs) for the characterisation of acoustic waves on Defence platforms. The work builds on an existing international collaboration between the DST Group and the U.S. Office of Naval Research and will involve the design, construction and testing of a laser based interrogation system designed to detect and characterise acoustic waves via optical fibre based sensing networks and integrated into the structure.

The job itself will involve exposure to and the involvement in all aspects of the project including top level architecture, system design, electronics and software development, installation and testing of the fibre optic sensing network, integration of the optical system into existing acoustic excitation systems and finally testing on a representative airframe substructure.

The successful applicant will have the opportunity to publish their work and, if appropriate, present at a local Australian scientific/engineering conference.

Project Objectives:

1. Under direction, assist in the design, assembly and testing of a laser-based system for simultaneous interrogation of multiple FBGs, including software development and integration;

2. Contribute to laboratory based experimental validation on a representative test bed; and

3. Record and analyse system performance and report on the findings.

Project Activities:

1. Mid-year report;

2. Final report; and

3. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Mechanical Engineering;
- Materials Science;
- Engineering;
- Physics;
- Mathematics;
- Software Development; and
- Electronical Engineering.

IEP AD 08: Measuring 3D features on small fatigue crack fracture surfaces

Location: Fishermans Bend, Victoria

Project Description:

Modern aircraft are designed to be both light weight and durable, and in the case of combat airframes, the structure is frequently highly loaded. The useful life of any aircraft in service is often set by the durability (fatigue life) of major load carrying components in the airframe. Failure of which result in catastrophic consequences or significant loss of capability and/or availability to the RAAF.

For metallic aircraft structural components that are designed with a finite durability of life, damage accumulates during service as fatigue cracks. The growth and coalescence of fatigue cracks ultimately result in a degradation of the components' strength and hence ability to carry load; which can compromise the structural integrity of the entire airframe. These fatigue cracks typically grow exponentially in service, thus most of the fatigue life of a component will be spent while the crack is significantly shorter than its final critical length.

The TASC (threshold and small crack) research program aims to enhance DST Group Aircraft Structure's capability by improving the accuracy of fatigue life predications (i.e. prognostics) and increasing our understanding of fatigue mechanisms in RAAF metallic components across all platforms. This project will, through investigation and measurement of 3D features on fracture surfaces, provide valuable data to be used to validate and further develop fatigue lifting models used to support current and future combat aircraft in service with the RAAF.

Project Objectives:

1. 3D measurement of fatigue fracture surface morphologies;

2. Digital recreation (and 3D printing) of very small segments fracture surfaces to aid crack path understanding; and

3. Identification of fracture surface morphologies as input to an automatic QF/ Crack growth measurement tool.

Project Activities:

1. Plan, write, undertake coupon fatigue test program and carry out the testing and analysis of the resultant fractures;

2. Quantitative Fractography of fatigue fracture surfaces using high-powered optical and electro-optical microscopes;

3. Measurement of 3D features on fracture surfaces using atomic force microscope and 3D optical scanner;

4. 3D-printing of (scaled-up) fatigue fracture surface segments;

5. Fatigue crack growth analysis;

6. Draft a conference/journal paper based on results; and

7. Final placement presentation.

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Relevant Research Areas and Desirable Skills:
• Engineering; • Materials science; and • Digital signal processing.

IEP AD 09: Vibration energy harvesting for airframes

Location: Fishermans Bend, Victoria

Project Description:

The position is located within the Airframe Diagnostics Systems group in the Aerospace Division, Fishermans Bend, Melbourne, VIC. The successful applicant will be expected to be a significant contributor to a programme of research investigating potential diagnostic health monitoring systems for use on Australian Defence Force air vehicles. In particular, the successful applicant will be involved in the development of techniques for parasitic energy harvesting from vibrating aircraft structures. These energy harvesting devices should be capable of harvesting power from airframe accelerations using novel transducer materials, with the goal of power structural health monitoring devices. Additionally, the successful applicant may be involved in developing a laboratory flight demonstration of autonomous airframe diagnostic sensor systems, including vibration energy harvesting approaches and airframe sensors. The flight based on a tethered DJI S900 hexacopter drone. The long term goal will be to incorporate vibrational energy harvesting capabilities into aircraft non-intrusive flight test instrumentation and/or structural health monitoring systems.

The job itself will involve assisting DST Melbourne personnel in the development, manufacture and evaluation of vibration energy harvesting devices. The applicant will be required to carry out a variety of different tasks. Tasks include mechanical and/or electronic design, code/script development, model development, and experimental validation. The experimental studies will require taking measurements under laboratory conditions and then analysing the data where necessary and reporting on the findings. The applicant can expect to develop various specific skills during the 12 month posting e.g. Matlab scripting may be used for COMSOL finite element Multiphysics modelling. Matlab may also be used for automation of various laboratory tests. Solidworks may be used for the development of mechanical design ideas for 3D printing of devices. The applicant may be exposed to C, C++, required for low power embedded microcontrollers, and high power Digital Signal Processing. Other scripting approaches may be implemented for LTspice electronic simulations (Perl and VBA). Additionally, the applicant has the option of developing their technical communication skills by presenting their research findings at an Australian scientific/engineering conference.

Project Objectives:

1. The development of techniques for parasitic energy harvesting from vibrating aircraft structures;
2. Laboratory flight demonstration of autonomous airframe diagnostic sensor systems, including vibration energy harvesting approached and airframe sensors;
3. Development, manufacture, evaluation and application of vibration energy harvesting devices using novel transducer materials;
4. Tasks include mechanical and electronic design, code/script development, model development, and experimental validation;
5. Experimental studies will require taking measurements under laboratory conditions and the analysing the data where necessary and reporting the findings;
6. Automation of various laboratory tests e.g. using Matlab Scripting;
7. Finite element analysis e.g. using Comsol Multiphysics;
8. Development of mechanical design ideas for 3D printing e.g. using Solidworks; and
9. Optionally, the applicant can further develop their technical communication skills by presenting their research at an Australian scientific/engineering conference.

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Project Activities:
1. Mid-year report; 2. Final report; and 3. Final placement presentation.
Relevant Research Areas and Desirable Skills:
• Mechanical Engineering; • Materials Science; • Engineering; • Physics; • Mathematics; • Software Development; • Electronical Engineering; • Matlab; • Comsol; and • Code and/or script development.

IEP AD 10: Autonomous Vehicles Operating in Complex Environments –A

Location: Fishermans Bend, Victoria : Edinburgh, South Australia
Project Description:
The Defence Science and Technology (DST) Group is conducting research on the use of autonomous aircraft and ground robots in urban terrain, including indoor environments. The research has the goal of developing machine-cognition technologies and them demonstrating in conjunction with new sensing to enable missions for intelligence, surveillance, and reconnaissance; contaminant-source localisation and tracking; and humanitarian assistance and disaster relief in complex, congested, and potentially contested environments. Two students are sought to assist with laboratory demonstrations of advanced sensors (e.g. single-photo diode arrays and night-vision sensors), autonomous search and mapping algorithms, robotic teaming etc. The students will work directly with DST Group staff to carry out the laboratory components of this project and will work largely independently to carry out its non-laboratory components.
Project Objectives:
1. To design and build robotic systems capable of operating in the challenging conditions of an urban environment; 2. To integrate novel sensor systems into multi-rotor and ground vehicle platforms that can perform surveillance, chemical localisation, and other missions in urban environments; and 3. To demonstrate the resulting systems in representative indoor and outdoor trials facilities.
Project Activities:
1. Electro-mechanical design; 2. Laboratory experimentation; 3. Control-system development and testing; 4. Data analysis; 5. Programming (e.g. in C++, ROS, and MATLAB); 6. Report writing; and 7. Final placement presentation.
Relevant Research Areas and Desirable Skills:
• Robotics; • Machine learning; • Mechatronics; and • Software engineering.

IEP AD 11: Autonomous Vehicles Operating in Complex Environments –B

Location: Fishermans Bend, Victoria : Edinburgh, South Australia

Project Description:

The Defence Science and Technology (DST) Group is conducting research on the use of autonomous aircraft and ground robots in urban terrain, including indoor environments. The research has the goal of developing machine-cognition technologies and them demonstrating in conjunction with new sensing to enable missions for intelligence, surveillance, and reconnaissance; contaminant-source localisation and tracking; and humanitarian assistance and disaster relief in complex, congested, and potentially contested environments. Two students are sought to assist with laboratory demonstrations of advanced sensors (e.g. single-photo diode arrays and night-vision sensors), autonomous search and mapping algorithms, robotic teaming etc. The students will work directly with DST Group staff to carry out the laboratory components of this project and will work largely independently to carry out its non-laboratory components.

Project Objectives:

1. To design and build robotic systems capable of operating in the challenging conditions of an urban environment;

2. To integrate novel sensor systems into multi-rotor and ground vehicle platforms that can perform surveillance, chemical localisation, and other missions in urban environments; and

3. To demonstrate the resulting systems in representative indoor and outdoor trials facilities.

Project Activities:

1. Electro-mechanical design;

2. Laboratory experimentation;

3. Control-system development and testing;

4. Data analysis;

5. Programming (e.g. in C++, ROS, and MATLAB);

6. Report writing; and

7. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Robotics;
- Machine learning;
- Mechatronics; and
- Software engineering.

IEP CEWD 01: Investigation of Network Control Protocol Vulnerabilities

Location: Edinburgh, South Australia

Project Description:

There is an implicit reliance on telecommunication networks to keep us always connected. Research over the past 20 years has demonstrated that attacks on network control plane protocols can have significant consequences, including delays, eavesdropping, partitioning and black holing. Discovery of routing protocol vulnerabilities is non-trivial; requiring a deep knowledge of protocol specifications in order to understand their impact and develop mitigation strategies. The aim of this project is to research one or more known routing protocol vulnerabilities in order to understand and inform on its behaviour, the real world impact and consequences.

Project Objectives:

1. Under guidance, research one or more known routing protocol vulnerabilities, implementing code that can be used to analyse its behaviour;

2. Characterise the behaviour and evaluate the real world impact of the vulnerabilities explored; and

3. Propose mitigation strategies (where time permits).

Project Activities:

1. Become familiar with the role that routers and routing protocols play in controlling how traffic moves across a network. Focussing on a specified routing protocol, develop a deeper understanding of its functions and how it operates to inform routing decisions.

2. Having been provided with one or more known routing vulnerabilities, review the related literature;

3. Develop a methodology and design one or more experiments that can be used to explore and evaluate a given routing protocol vulnerability;

4. Become familiar with a network emulation testbed and implement code to conduct repeatable experiments to analyse the behaviour;

5. Compare and contrast findings with existing literature, explore and assess the real world impact of a given vulnerability and propose mitigation strategies;

6. Produce a technical report that will summarise the routing protocol vulnerabilities studied from literature, describe the approach taken for testing and evaluation including any assumptions made and how data was collected, present the results and discuss the implications of the findings;

7. Periodically report on the above findings and present on this work; and

8. Present a final placement presentation.

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Relevant Research Areas and Desirable Skills:
• Telecommunications; • Computer Network; • Electrical; • Electronic Engineering; • Computer Science; • Information Technology (Networking); • Networking architectures and technologies; • Switching and routing protocols; • TCP/IP protocol suite; • Software programming and scripting languages (e.g. Python); • Familiarity with Linux; and • Willing to learn new skills and tackle complex problems; and able to work independently;

IEP CEWD 02: Developing Reverse Engineering Tools for Malware Analysis

Location: Edinburgh, South Australia
Project Description:
Cyber Assurance and Operations Branch is undertaking ongoing research and development in the area of automated reverse engineering. The candidate would be involved in developing and adapting software that performs automatic analysis of malware. In particular, the candidate would focus on code deobfuscation, with some freedom on the specific direction. We would support the student in developing existing skills in reverse engineering and malware analysis.
Project Objectives:
1. Deepen an understanding of reverse engineering, as applied to malware; 2. Develop an understanding of obfuscation techniques employed by malware authors; and 3. Develop proof of concept de-obfuscation techniques.
Project Activities:
1. Compare reverse engineering training on tools and sample malware; 2. Limited research into related topics in cyber security; 3. Gain familiarity with our development environment; 4. Design and develop concept demonstrator for a complex de-obfuscation technique; and 5. Final placement presentation.

IEP CEWD 03: Machine Learning in Support of Identification of Software Vulnerabilities

Location: Edinburgh, South Australia

Project Description:

Investigate and develop new and novel technologies and techniques in machine learning to aid in the identification of vulnerabilities in software. In particular, we are seeking to research and develop scalable predictive machine learning techniques that exploit code structure and code behaviour patterns in order to more effectively guide and assist the security analyst/auditor in the identification of software vulnerabilities in large code bases.

Project Objectives:

1. Determine features relevant to classification of vulnerabilities in source code (C, etc.) and binaries; and

2. Develop and test new and novel tools and techniques to assist in the identification of software vulnerabilities.

Project Activities:

Specific activities to be undertaken will be negotiated based upon priorities and project status at the time, as well as the student's capabilities and preferences for research direction. The student will be part of a team of DST Group researchers working in the area.

1. Develop an understanding of code vulnerabilities and their classification and documentation;

2. Develop tools and techniques for extraction of information relevant to the identification and classification of vulnerabilities from source code using tree/graph mining techniques on, for example, abstract syntax trees;

3. Development and implementation of machine learning technologies and techniques for identification of vulnerabilities in source code;

4. Extension of the above tools and techniques to identification of vulnerabilities in binary code; and

5. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Strong computer science knowledge, with experience of programming in Python; and
- Also advantageous would be some experience in one or more of statistics, machine learning, C++ and computer security.

IEP CEWD 04: Autonomic/self-adaptive computing for cyber security systems

Location: Edinburgh, South Australia

Project Description:

DST Group's Cyber Assurance and Operations Branch is undertaking ongoing research and development in the area of autonomous cyber defence systems, which combine dynamic, distributed security attack detection/response with vulnerability assessment and mitigation.

In this year-long project, the candidate will learn about and contribute to the area of distributed autonomic/self-adaptive computing – an area that is at the fore-front of modern R&D – with options to delve more deeply into aspects of software security, fault tolerance and algorithm design, depending on interest and aspiration. More specifically, the candidate will work as part of a team and be involved in researching and developing software modules implementing various techniques for decentralized self-management in the context of an existing software prototype, focusing on the enforcement of one or more classic autonomic self-* properties: self-protection (how the system can defend itself against security attacks), self-healing (how the system can detect and recover from partial failures) and/or self-configuration (how the system can deploy/re-deploy itself across a network and modify its configurations). No prior knowledge is expected beyond completion of a standard 2nd year computing curriculum, and ongoing coaching will ensure the candidate is well supported. The skills, experience and knowledge gained while working on the project would be widely applicable to many areas in computer science and software engineering.

Our team includes researchers and software engineers developing novel concepts and tools for building the autonomous cyber defence systems for the future. We are seeking a student who is keen to work with our team members, to learn about exciting new technologies, to acquire new skills, and to make positive contributions to a real-life R&D project.

Project Objectives:

1. To acquire a good understanding of the concepts underlying autonomic/self-adaptive computing and how these apply to autonomous cyber defence; and

2. To undertake software development activities resulting in tangible contributions towards new and/or existing software prototypes.

Project Activities:

1. Familiarisation with our development environment, tools and technologies;

2. Familiarisation and/or basic research in selected topics from autonomic computing, software security, distributed systems and related areas;

3. Individual and team-based software development of various modules using potentially novel algorithms and data structures, contributing to parts of an ongoing prototype;

4. Planning and time management; and

5. Preparation of a written report and (final placement) oral presentation on the R&D work performed during the period.

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Relevant Research Areas and Desirable Skills:

- Distributed and networked systems;
- Autonomic/self-adaptive computing;
- Cyber security;
- Software engineering;
- Studying for a degree in computer science, software engineering or related discipline;
- General software development skills (Golang will be the main programming language used, so experience with related languages such as C/C++, Java or Python is desirable);
- Good communication skills;
- Ability to work in teams;
- Motivated and goal-focused; and
- Interested in learning new concepts.

IEP JOAD 01: Towards an Organisational Agility Maturity Model

Location: Fishermans Bend, Victoria

Project Description:

While the importance of agility has long been recognised by Defence, there is no universal agreement (in Defence or in the broader scientific literature) on the exact definition of the term, or how agility may be assessed and improved. This study aims to contribute to the development of an organisational agility maturity model, a methodology and a best-practice benchmarking tool for evaluating organisational agility and developing relevant improvement strategies. The study may deal with any of the following aspects in relation to organisational agility: organisational learning, knowledge management, strategic management, research and development, governance, culture, change management, decision making, leadership, risk management etc.

Project Objectives:

1. Targeted literature review;
2. Conceptual framework; and
3. Draft journal paper.

Project Activities:

1. Conduct a targeted literature review on one of the relevant aspects (maturity indicators) as outlined project description;
2. Integrate the literature review into a conceptual framework;
3. Relate the conceptual framework to other maturity indicators (preliminary maturity model);
4. Contribute to a journal paper on the topic; and
5. Final presentation.

Relevant Research Areas and Desirable Skills:

- Organisational science;
- Management science; and
- Strategic business management.

IEP JOAD 02: Experimental Study Into Technology Forecasting

Location: Fishermans Bend, Victoria

Project Description:

This position is located within the Aerospace Capability Analysis (ACA) branch in Joint and Operations Analysis Division at Fishermans Bend.

The successful applicant will contribute to a programme of research that seeks to improve the accuracy of technology forecasting based on expert judgement, in support of Air Force. Anticipating and understanding technology developments and the future context in which Defence will operate is critical to developing a relevant and robust future Defence Force.

This student project involves working within our multi-disciplinary team to design and implement an experiment that tests established theory on forecasting in a Defence context. Potential topics (to be further refined) include:

- Experiments to assess how to best elicit and aggregate expert judgement for technology forecasting;
- Investigating the concept of 'expertise' in Defence and how it impacts forecasting accuracy in judgement-based forecasting; and
- Testing the impact of participant diversity (demographics, cognitive styles etc.) on forecasting accuracy.

This project will provide the participating student with an excellent opportunity to contribute to theory and the development of effective techniques for Defence planning for an uncertain future. It will also provide insight into the broader research and analysis conducted in Aerospace Capability Analysis branch relevant to strategic decision-making, such as scenario planning, experimentation and war gaming.

Project Objectives:

1. Collect empirical data on the efficacy of forecasting technique(s) in a Defence context;
2. Contribute to forecasting theory (research to be published); and
3. Improve the rigour of techniques used by ACA to support Air Force decision-making.

Project Activities:

1. Read relevant scientific papers, reports, guidelines etc. to increase knowledge of forecasting, expert judgement elicitation and the Air domain;
2. Prepare literature reviews and summaries;
3. Contribute to the design of an experiment to test a specific aspect of forecasting in a Defence context;
4. Contribute to the conduct of an experiment (preparation of materials, data collection, facilitation etc.);
5. Apply analytical techniques to interpret results;
6. Reporting on findings; and
7. Final placement presentation.

Relevant Research Areas and Desirable Skills:
• Risk analysis; • Technology development; • Geopolitics; • Economics; • Psychology; • Cognition; • Social science; • Experimental design; and • Statistics.

IEP JOAD 03: Developing an Aerospace Simulation Capability for Analysing Defence Operations

Location: Fishermans Bend, Victoria

Project Description:

1. Python-based model development for simulation of aerospace operations. Includes sensor, weapon and platform computational models. Student to be given specific functional requirements and MatLab code examples at the beginning of the project;

2. Artificially intelligent agent-based modelling with Python. Suitable candidate to develop a user friendly interface and backend for rapidly prototyping and simulating tactical responses in aerospace simulation; and

3. Conduct horizon scanning activities that investigate future technologies/capabilities and emerging SA/OR methods relevant to aerospace operations.

Project Objectives:

1. To develop a flexible, deployable, simulation framework, written in Python, by working in a team across the whole software development lifecycle. The aim is to produce a cost-effective, easy to use capability for operational analysis. This capability will be used by Defence to improve its effectiveness in conducting aerospace operations;

2. To develop a flexible, capable tactics modelling environment. This capability will be written in Python, and will allow Defence operators to improve tactics, techniques and procedures employment in real-world missions; and

3. Conduct horizon scanning in relevant fora to allow DST Group to remain at the forefront of aerospace operations research and development.

Project Activities:

1. Models developed in Python in accordance with:

    a. best software engineering practices;

    b. aerospace systems analysis functional requirements;

    c. aerospace capability needs; and

    d. military decision-making processes.

2. Software specification wiki that clearly specifies IO requirements and provides use-case examples;

3. Monthly group presentation and short summary on aerospace operations, summarising highest impact/highest interest in:

    a. technologies and capabilities; and

    b. SA/OR methods.

4. Final placement on approaches developed/used for model development; and

5. Final placement presentation.

Relevant Research Areas and Desirable Skills:

Python experienced is highly desirable.

IEP JOAD 04: Simulation Data Science

Location: Fishermans Bend, Victoria

Project Description:

The project involves developing a simulation data science software toolkit for the analysis of air operations simulation data. This will include statistical analysis and visualisation of simulation results using the Python programming language and the Python scientific stack (NumPy, SciPy, Pandas).

Project Objectives:

1. Develop a computational statistics toolkit for the analysis of air operation simulation data; and
2. Develop a charting and visualisation toolkit for the interpretation of statistical analysis of air operation simulation data.

Project Activities:

1. Software requirements elicitation and specification;
2. Architectural design;
3. Implementation of statistical analysis toolkit;
4. Implementation of statistical visualisation toolkit;
5. Test plan and test results of toolkit; and
6. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Software engineering;
- Computer Science;
- Computational Statistics;
- Mathematical analysis;
- Computer programming;
- Python programming language; and
- Python scientific stack e.g. NumPy, SciPy, Pandas.

IEP JOAD 05: Network-Based Distribution in Uncertain Environments

Location: Edinburgh, South Australia

Project Description:

Investigate and develop a variety of algorithms for the Network Distribution Problem (NDP). The NDP involves routing supplies from a source node to multiple sink nodes using a supply network and set of transports. The network and transports are subject to various fundamental uncertainties, such as surge demand, link failure and transport downtime, so supplies may be stockpiled at intermediate locations throughout the network as a buffer against uncertainty. We are interested in exploring different techniques for effectively dealing with the uncertainty in these networks while meeting the demand at the sink nodes.

Project Objectives:

1. Investigate a range of algorithms and techniques for the network distribution problem;

2. Implement a selection of algorithms that are best suited to the problem; and

3. Evaluate and compare these algorithms to understand their benefits and drawbacks, as well as their effectiveness in dealing with uncertainty.

Project Activities:

1. Survey of existing techniques and algorithms (with a focus on specific areas of interest);

2. Implementation of one or more selected algorithms in Python or Java;

3. Final report including a summary of the findings of the survey, a description of the implemented algorithms, and a detailed evaluation and comparison of techniques; and

4. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Software development;
- Python;
- C++;
- Java;
- Machine Learning; and
- Optimisation Planning.

IEP JOAD 06: Developing Visualisation and Analytical Support Tools to Manage Defence Investment Decisions

Location: Fairbairn, Australian Capital Territory
Project Description:
Defence is under-going a process of collating and integrating its information into common repositories. The Strategic Capability Analysis (SCA) Branch within DST Group has been developing a decision-support, visualisation tool, entitled "Program Viewer", to aid in the collation and representation of scheduling and costing dependencies. SCA Branch requires an applicant that has initiative and motivation, strong programming skills (Java), but also has a willingness to participate in analysis and modelling of Defence, its information and its organisational structure. The project will be hosted by the Strategic Capability Analysis Branch and will provide the participating student with an excellent opportunity to gain understanding of the capability development process in Defence and develop effective solutions to complex strategic planning problems through the application of analytical techniques and programming.
Project Objectives:
1. Assist the development of the decision support tool Program Viewer to support the analysis and visualisation of Defence investment programming decisions. This may include the generation of a geographical interface.
Project Activities:
1. Designing and coding aspects of the decision support tool; 2. Collecting data from various sources and implementing models in a suitable tool such as Excel; 3. Contribute to the writing of documentation; 4. Presenting a briefing about their work; and 5. Final placement presentation.

IEP JOAD 07: Applying Risk Management to Define Capability Investment Priorities

Location: Fairbairn, Australian Capital Territory
Project Description:
In the current fiscal environment there is a need in Defence to support evidence-based decision-making associated with the prioritisation and optimisation of existing and future major Defence capabilities, infrastructure projects and facilities. This student research project will focus on the development of a scientifically based investment prioritisation methodology to assist better decision-making in designing and managing complex investment portfolios in Defence. The project will be hosted by the Strategic Capability Analysis Branch and will provide the participating student with an excellent opportunity to gain understanding of the capability development process in Defence and develop effective solutions to complex strategic planning problems through the application of analytical techniques.
Project Objectives:
1. Development of a scientifically based investment prioritisation methodology to assist better decision-making in designing and managing complex investment portfolios in Defence.
Project Activities:
1. Reading and studying relevant scientific papers, reports, policies, guidelines and manuals; 2. Preparing literature reviews and summaries; 3. Conducting analysis and developing risk based investment models; 4. Collecting data from various sources and implementing models in a suitable tool such as Excel; 5. Writing a short research report; 6. Presenting a briefing about their work; 7. If the successful candidate has mathematical skills there could also exist an opportunity to conduct quantitative and statistical analysis and modelling; and 8. Final placement presentation.

IEP JOAD 08: Automated Data Discovery (ADD)

Location: Edinburgh, South Australia

Project Description:

Defence needs data about the capabilities and capacities of civil infrastructure (e.g. transport, medical, fuel) that could be used to support ADF activities. Data analysis and fusion components are currently under development. However, components do not yet exist to identify deficiencies in the available data (e.g. missing data or data is too old), to prioritise those deficiencies and then find data from sources that can be used to rectify those deficiencies. Those data sources may be on Defence or civilian networks and will vary from being untrusted to authoritative.

It is anticipated that technologies relevant to those components will be reviewed in FY15/16 by the Autonomous Situational Awareness Agents (ASAA) project currently supported by the Trusted Autonomy SRI. Furthermore, an autonomous multi-agent system is scheduled to begin implementation in FY16/17.

Therefore, an IEP student is sought to join a small Science and Technology (S&T) team to consider the findings of that technology review and the subsequent implementation, and advise how best to integrate relevant aspects with the data analysis and fusion components. Following the decision on which approach to pursue, the student will then commence work on implementing that approach.

Please note that the scope of implement is beyond a single IEP placement.

Project Objectives:

Outcome

To have a way forward for automatically improving the quality of the data available for analysis.

Objectives

a. Developed a system architecture to guide the integration of various technologies, particularly for automated data discovery;

b. Developed an ability to identify and maintain a list of prioritised data deficiencies; and

c. Developed an ability to automatically obtain the data needed to address those deficiencies.

Project Activities:

1. Collaborate with the S&T team to develop a system architecture including simple APIs for communication between components.

Deliverable - Documented the system architecture on the S&T teams' wiki. This architecture will evolve over time to incorporate other components noted below.

2. Consider the ASAA technology review and progress with the multi-agent implementation.

Deliverable - Describe the relevant aspects of the ASAA technology review and its multi-agent implementation, and how they fit into the system architecture.

3. Develop two or three different approaches to integrate aspects from the ASAA project with the data analysis and fusion components.

Deliverable - Describe the alternative approaches on the wiki.

4. Present and debate the alternative approaches with the S&T team.

Deliverable - Provide a more detailed description of the approach being implemented that would be sufficient for a subsequent IEP student to carry on this work in a later financial year.

5. Partially implement the selected approach in accordance with guidance from the S&T team.

Deliverable:

i. Integrate an ability to maintain priority data deficiencies;

ii. Direct ASAA-based agents to find data resources that are likely to contain details relevant to priority data deficiencies;

iii. Provide those resources to data extraction components that were reviewed by the ASAA project;

iv. Provide extracted details along with metadata to the data fusion component.

6. Final placement presentation.

Relevant Research Areas and Desirable Skills:

1. Web standards and technologies;

2. Service oriented architecture;

3. Information retrieval;

4. SOLR enterprise search engine;

5. Java and other programming languages; and

6. Autonomous multi-agent systems.

IEP JOAD 09: Interactive Multimedia Storytelling with Virtual Humans for Autonomous Systems

Location: Edinburgh, South Australia

Project Description:

DST Group's Project Tyche is exploring how autonomous Artificial Intelligence (AI) and trusted interfaces can be used to support military operations and intelligence analysis, in collaboration with international partners. The development of an interactive multimedia storytelling capability to provide situational awareness, leveraging existing in-house capabilities, is a key element to achieving a trusted interface to autonomous systems in these use cases. In this project the student will extend and/or develop interfaces enabling multimedia storytelling, including web technologies, to support our international collaboration.

Situational awareness is a key requirement for decision makes and analysts. In the normal course of their roles this can be achieved, in part, by exploration and manipulation of the data space in order to produce the products needed to support their analysis and decisions. This helps establish the context, and determine what is known, what is not known, and what is important and what is not important to a particular situation. When automation is introduced to handle large data sets, this pathway to situational awareness is largely lost. However, storytelling is widely regarded as an effective mechanism for experientially engaging an audience, and thus can establish the context needed to achieve situational awareness in these circumstances. Beyond this, narration associated with multimedia content can help explain a graphic, animation, or scene, and point out the significance of what is being displayed. Therefore, we have been exploring the use of automated multimedia narrative, based around animated virtual human characters coupled with text, images, videos, graphs, diagrams, 2D/3D animations and geospatial scenes, as a means of providing users with the elements needed to achieve situational awareness when automation is used for data analysis and fusion. In particular, interactive virtual humans have the potential to provide an engaging narrative that goes beyond a simple 'voice-over', through the display of appropriate emotions and the use of appropriate gestures. Modelling of the user's cognitive and emotional state and that of the virtual human 'storytellers', is important to achieving this engagement. With the increasing shift towards autonomous systems with 'humans on the loop' rather than 'human in the loop', there will be an increasing need for such engaging interfaces.

Project Objectives:

1. Develop and/or extend applications for the generation and presentation of multimedia narrative, including virtual human story tellers and geospatial animation;

2. Understand and characterise the data and presentation requirements for the use-cases developed for internal and international demonstrations;

3. Integrate these applications with data sources and third-party systems available in internal and international demonstrations; and

4. Provide technical support as required to prepare and conduct internal and international demonstrations.

Over page

Project Activities:

1. Software is developed following current established best practices such as the use of an agile development methodology and continuous Integration;

2. All source code is appropriately commented and checked into DST Group code repository;

3. Working software is deployed on the Research Network;

4. All supporting configuration instructions, operating instructions and lessons-learned documentation are provided in an agreed format;

5. Final placement presentation; and

6. Final placement report

Relevant Research Areas and Desirable Skills:

- Semantic Web;
- Multimedia;
- Graph database;
- Natural language generation;
- Interactive Virtual Human;
- Geospatial Intelligence;
- Computer Science;
- Web application development;
- JavaScript programming;
- Java programming; and
- Software engineering.

IEP JOAD 10: Immersive Battlespace Demonstrator Enhancement

Location: Fairbairn, Australian Capital Territory

Project Description:

The Immersive Battlespace Demonstrator (ImBaD) is a first person virtual reality battlespace exploration tool for use in exploring future war fighting concepts for the Australian Defence Force (ADF).

The project is to develop elements of the ImBaD tool to extend its capability to support a wider range of operational HQ roles, especially where those relate to the Joint Fires capability area as it is envisaged to be in the 2035 to 2050 timeframe.

The ImBaD tool is a first person virtual reality-sandbox environment in which the user can wander around a theatre of operations at the scale of a titan and shrink down at will to explore in more detail. The use will utilise advanced Virtual Reality tools to do their job and have suitable devices (such as Virtuix Omni and motion capture or tracking devices) to facilitate this.

ImBaD is being developed using the Unreal game engine and using the Open Systems VR ecosystem to utilise a wide range of VR related hardware.

The behaviour of some complex elements will run in specialised simulation engines linked to object in ImBaD as synchronised HLA federates. Similarly, various information sources and communication mechanisms will also be made available in ImBaD.

Project Objectives:

1. Develop understanding of a specific operational HQ and how that role is likely to change in the future;

2. Design and implement enhancements to support use of the tool for that roles as it is expected to be in the future; and

3. Develop the information packages required to support use, evolution and maintenance that enhancement.

Project Activities:

1. Develop an initial familiarity with the workings and construction of the ImBaD Tool, the Unreal engine, the Joint Fires capability area, the JCA MSTC's work in this area, and the Operational HQ roles which relate to joint fires (Timeframe – three weeks).

2. Interact with Defence and DST Group subject matter experts to understand how the specific Operational HQ roles (related to Joint Fires or Targeting) is likely to be in the future and how it could best benefit from using the VR Battlespace Tool. The analysis report would be reviewed and when approved constitute deliverable one (Timeframe – three weeks).

3. Determine what enhancements could/should be made to suit the tool to those needs. The requirements report be reviewed and when approved constitute deliverable 2 (Timeframe – two weeks).

4. Research the best approach to achieving the desired results within the ImBaD tool with the available time and resources. When approved, the proposed approach would constitute deliverable three (Timeframe – two weeks).

5. Design, implement and test the agreed enhancements to the tool. When approved, the proposed approach, design and successful test report would constitute deliverables four and five.

Design and implementation would be carried out using a phased approach using an Agile-like methodology so that even if not all enhancements could be completed in the time frame, the role's needs would be substantially met and a basis for any remaining enhancements well laid (Timeframe – 20 weeks).

6. Develop a demonstration plan and demonstrate the enhancements to the client and other Defence stakeholders. When reviewed and approved the demonstration plan would constitute deliverable six (Timeframe – one week).

7. Develop technical guidance to facilitate understanding of the requirements of the role in the future, how the enhancements are intended to support that role and how to maintain those enhancements. When reviewed and approved the technical documentation would constitute deliverable seven (Timeframe – four weeks).

8. Develop in-game user guidance and a video tutorial to facilitate exploit of the VR Battlespace tool for that roles' future needs. When reviewed and approved the training documentation would constitute deliverable eight (Timeframe – four weeks).

9. Final placement presentation – ideally supported by live demonstration of the new capability (Timeframe – one week).

Relevant Research Areas and Desirable Skills:

- A familiarity with developing in the C++ language;
- Some training in systems or operational analysis; and
- Some training in the design of object oriented software.

IEP JOAD 11: Modelling and Simulation for Joint Fires Experimentation

Location: Fairbairn, Australian Capital Territory
Project Description:
Developing of modelling and simulation tools for the improvement of joint fire support in the Australian Defence Force (ADF)
Project Objectives:
The objective of this project is to model the ADF targeting and fire support processes in order to study the current and new sensor to shooter workflow. The development of a serious game environment based on a combination of process modelling and immersive techniques is used as a means by which current and future processes in the ADF war fighting capability can be analysed and evaluated to help identify process bottlenecks and suitable alternatives.
Project Activities:
1. Develop organisation models using organisation simulation tools (e.g. SimVision) to measure how well and organisation can accomplish the required work. This set of models will be used to assess organisational efficiency and staff effort in managing the work; 2. Develop process models using workflow modelling tools for process improvement. This set of discrete event simulation models will be used to describe the workflow of dynamic targeting and determine the improvements that could be made for better performance, including staff workload, timeliness, and potential bottlenecks in command and control; 3. Develop system models based on model-driven architecture methodology (e.g. Artisan Studio) to express modelling concepts. It will take the systems engineering viewpoint and look at the entire system lifecycle, including new systems and their interoperability requirements; and 4. Final placement presentation.
Relevant Research Areas and Desirable Skills:
• Computer Science; • Information Technology; • Programming experience; and • Simulation experience.

IEP JOAD 12: FOEVVS JCATS Data Generation

Location: Fishermans Bend, Victoria : Edinburgh, South Australia

Project Description:

The FOEVVS library is used to produce the data requirement for closed loop simulation tools used by LSEW to explore issues for analysis. These closed loop tools have significant data requirements that excel the ability to manually collect the correct data. FOEVVS provides a solution of generating this data from a minimal set of easily obtained data. FOEVVS also includes several other data generation tools such as Ballisticus or Bang.

The FOEVVS library uses data formatters to adjust the generated data into a format that can be imported to different simulation tools. To enable closer integration of Army and DST Group tools FOEVVS can have support to produce JCATS table data added.

Once FOEVVS is able to produce simulation data in JCATS format adjustments will need to be made to command line generation tools and software libraries. The changes should also be added to the SimR data generation and management software developed by DST Group.

A student selected for this position will require software development skills and strong mathematics understanding. The student will gain experience in developing implementations of mathematically complex problems and design modular software components that can be used in a multitude of applications.

Project Objectives:

1. JCATS data output for FOEVVS library;
2. Command line and distributed library implementations of algorithms; and
3. SimR integration of JCATS output.

Project Activities:

1. JCATS data table generation;
2. Unit Test Suite development;
3. SimR integration of JCATS exporter;
4. Additional data exporters;
5. Progress demonstration;
6. Command Line Interface alterations;
7. GUI improvements and extra control options; and
8. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Software Development skills;
- Strong mathematical understanding; and
- Java knowledge.

IEP JOAD 13: SimQ interface improvement

Location: Edinburgh, South Australia

Project Description:

The SimQ system provides a management interface for distributing simulation executions across a network of computers and collating and processing the gathered results to make them ready for data analysis. Using SimQ reduces the time analysts spend managing the complex process of data generation by taking care of data movement and asynchronous processing. The control interface is simulation agnostic allowing us to utilise any simulation tool or other intensive processing tasks.

The SimQ system currently has a limited interface that enable applications to be added and results recorded. The interface and control software still presents problems for the analyst and needs improvements to be made. Under guidance of a competent software supervisor and with direct feedback from an analyst the interface will be changed to make configuration easier and to provide meaningful metrics to track the progress of the simulation execution.

The applicant wills require skills in user interface design and web technologies. They will need to be comfortable in operating with Windows and Linux operating systems. From the project they will develop stronger skills in web design and experience with developing distributed processing applications.

This component will involve making changes to the existing SimQ application or potentially improving the features of a distributed processing environment being developed via a Research Agreement. For either base of distributed processing the top level application will still need changes.

Project Objectives:

1. Enhanced user interface for SimQ and related tools, allowing for improved monitoring of SimQ activities;

2. Greater robustness of SimQ, especially in the distribution and execution of tasks; and

3. Ability to run additional simulation tasks in a distributed manner.

Project Activities:

1. Improvements to the Web application interface;

2. Improvements to server and client to enhance robustness;

3. Modifications to server and client to allow simulation tasks to run in a distributed manner;

4. Progress presentation;

5. Documentation of SimQ interface; and

6. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Requires skills in user interface design and web technologies; and
- Must be comfortable operating Windows and Linuz systems.

IEP JOAD 14: Terrain Repository - Ongoing Development

Location: Edinburgh, South Australia

Project Description:

Combat Simulation and War gaming are tools used extensively in Land Capability Analysis. To support these tools, there is a requirement to manage large volumes of terrain data. This data comes from a variety of sources, both classified and public domain, and is in a variety of formats, including raster and vector-type data.

The project requirement is to continue development of a partially completed tool for managing this terrain data. This tool, known as the Terrain Repository or TerraR, has several components. These components include a server and user interface for ingesting and adding metadata to new terrain data, a network storage volume for storing the data, and a web-based client user interface for exporting and displaying the data as well as performing single geospatial processing, searching, and filtering operations.

Project Objectives:

1. Improve the existing user interfaces and component integration;
2. Add automated ingestion and volume management;
3. Add user account login and user tracking; and
4. Improve export for vector and raster data.

Project Activities:

1. Consolidate, package and tidy up existing code;
2. Modifications to user interface to enable data auditing and data ingestion;
3. Test ingestion of data;
4. Progress presentation;
5. Improve user interface and export functionality, time permitting;
6. Documentation of TerraR Interface; and
7. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Software engineering;
- Computer science;
- Information technology or similar fields;
- Java and JavaScript;
- Python;
- Mapping or geospatial software;
- User interface design;
- Web design;
- Version control software; and
- Experience in professional software development.

IEP JOAD 15: Design and Analysis of Simulation Experiments

Location: Edinburgh, South Australia
Project Description:
Land operations, particularly combat operations, are often modelled using closed-loop simulations. These allow multiple replications to account for stochastic elements in the model, and control over the input variables to observe the response in output variables(s). Two typical outcomes sought are the identification of sensitive factors that affect operational effectiveness, and the comparison of alternate capability options. This project will assist the Land Mathematical Sciences Group develop a Statistical Toolbox for the Design and Analysis of Simulations Experiments to achieve such outcomes.
Project Objectives:
1. Assessment of design of experimental statistical theories for application to land operations simulation analysis; and 2. Development of a toolbox of statistical procedures.
Project Activities:
Specific activities to be undertaken will be negotiated based upon priorities and project status at the time, as well as the student's capabilities and preferences for research direction. The student will be part of a team of DST Group researchers working in this area. Activities include: 1. Compare the utility of fractional-factorial designs as well as other Factor Screening Procedures such as the more recent method of sequential-bifurcation, and the more traditional methods such as Plackett-Burman designs; 2. Research alternative comparison objectives including Screening and Selection Procedures where either the best option or a subset containing the best option is selected and Multiple Comparison Procedures that provides information about the relationships between all options; 3. Assist in the translation of the various procedures (Factor Screening, Screening and Selection, Multiple Comparisons) from statistical theory to Toolbox code fragments; 4. Document findings in a written report; and 5. Final placement interview and presentation.

IEP JOAD 16: Maritime Fleet Scheduling

Location: HMAS Stirling, Rockingham, Western Australia
Project Description:
The project aim is to develop a model to determine an optimal allocation of maritime fleet resources (submarines and/or surface ships) that allow the RAN to achieve specific operational deployments, which are constrained by crew availability and periodic maintenance. The model needs to incorporate both planned and unplanned maintenance, a mixed fleet composition that changes over time and the requirement to surge capability to meet unexpected contingencies.
Project Objectives:
1. Examine different solution techniques to determine the preferred approach for implementation; 2. Develop a fleet scheduling model; and 3. Conduct sensitivity analysis to model parameters.
Project Activities:
1. Conduct literature review; 2. Implement an initial model of a steady state capability; 3. Conduct sensitivity analysis to examine which aspects drive performance; 4. Extend the initial model to incorporate random aspects; 5. Conduct sensitivity analysis of random aspects; and 6. Final placement presentation.

IEP LD 01: Collaborative Machine Learning for Autonomous Vehicles

Location: Edinburgh, South Australia
Project Description:
The Advanced Vehicle Systems (AVS) Science and Technology Capability (STC) provides support to Army and the broader Defence community on issues and opportunities of adopting and integrating advanced technology capabilities into Land Vehicles. Two characteristics of common challenges in land vehicles are 1) vehicles are never alone, and 2) individual vehicles rarely have sufficient capabilities for the most challenging situations. Hence, cooperative resource management and collaborative tasks are necessary. The student's involvement will focus on research into distributed machine learning in collaborative and adaptive resource allocation.
Project Objectives:
1. Identify and down-select a range of machine learning methods for application to the resource allocation task; 2. Understand and document the performance, requirements, constraints, and trade-offs of machine learning frameworks for collaborative and distributed resource allocation within the AVS simulation environment; 3. Establish an analytical framework; 4. Evaluate candidate methods using the framework; and 5. Make recommendations for future work in this area.
Project Activities:
1. Familiarise with AVS research into distributed decision making methods; 2. Demonstrate machine learning for the purpose of resource allocation within the AVS war game simulation environment; 3. Contribute to development of analysis criteria for machine learning frameworks; 4. Integrate competing machine learning frameworks into the AVS war game simulation environment; 5. Advise on strengths, weaknesses and future directions for work in this area in consultation with AVS researchers; 6. Final placement presentation on project outcomes, lessons learned and experience gained.

IEP LD 02: Collaborative Simultaneous Localisation and Mapping; A Hybrid Control Approach

Location: Edinburgh, South Australia

Project Description:

The research program of the Advanced Vehicle Systems (AVS) group seeks to identify opportunities and develop solutions to improve the resilience and adaptability of critical services on Army's future land vehicles. Modern land vehicles capabilities require increased agility in configuration, deployment and self-management of vehicle-hosted sensors and effectors.

In regard to controlling these systems, almost all operational systems are composed of both physical components that operate in continuous-time as well as cyber control, sensing and communication systems that live on embedded circuits and operate in discrete-event-time. Hybrid control is a modern control theory that addresses both the physical and the cyber parts of a system and their difference in time scales. Hybrid control has proven advantageous in systems involving groups of complex systems, sequential planning of complex autonomous behaviours and rigorous modelling of embedded control systems. This project involves research on cyber-physical systems, familiarisation with hybrid modelling tools, concept design and demonstration of hybrid control in a collaborative fleet of autonomous vehicles that perform Simultaneous Localisation And Mapping (SLAM).

Project Objectives:

1. Familiarisation with hybrid control methods (Reference book: Introduction to Embedded Systems, A Cyber-Physical Systems Approach. Lee and Seshia, 2015) relevant to the collaborative vehicles program of AVS;

2. Development, modelling and stability analysis of a collaborative simultaneous localisation and mapping (SLAM) concept;

3. Familiarisation with existing hybrid modelling tools either in Simulink or LabVIEW and analysis of the collaborative SLAM concept using the tool; and

4. Documentation of the collaborative SLAM concept and the associated analysis.

Project Activities:

1. Document of a report on collaborative SLAM and the associated analysis in the context of AVS collaborative vehicles program;

2. Demonstrate or document plans on integrating the collaborative SLAM concept with AVS vehicle systems;

3. Present on the concepts developed and the progress made; and

4. Final placement presentation.

IEP LD 03: Distributed Decision Making Application to support Autonomous Systems in Military Land Vehicles

Location: Fishermans Bend, Victoria : Edinburgh, South Australia

Project Description:

The research program of the Advanced Vehicle Systems (AVS) group seeks to identify opportunities and develop novel solutions to enhance the adaptability, tactical effects and resilience of critical services on Army's future land vehicles. This may be achieved through exploitation of redundant functionality afforded by distributed digital vehicle systems and utilisation of sensors and effectors on co-located vehicles in the land battlespace. To realise these capabilities, the AVS group is investigating the use of autonomic management of vehicle systems and distributed decision making concepts.

The student will focus on research into distributed decision making methods and tools to support autonomic self-management of services within military land vehicles. Previous research in this space has identified a collection of useful methods for distributed decision making. This project will research their validity and implementation in systems and scenarios of interest to AVS.

Project Objectives:

1. Understand and document the performance, requirements, constraints and trade-offs of specific distributed decision making methods in use cases within the AVE research scope; and

2. Provide recommendations as to tools for modelling and simulation of distributed decision making methods.

Project Activities:

1. Familiarise with AVS research into distributed decision making methods;

2. Contribute to development of analysis criteria for distributed decision making methods;

3. Contribute to the assessment and selection of tools for modelling and simulation of distributed decision making methods;

4. Develop simulations to provide concept demonstration of relevant distributed decision making methods;

5. Develop simulations to analyse the implementation and fitness of methods for distributed decision making between systems of interest in representative AVS scenarios;

6. Report on distributed decision making methods and associated analysis highlighting performance, requirements, constraints and trade-offs; and

7. Final placement presentation on project outcomes, lessons learned and experience gained.

IEP LD 04: Vehicle network controlled PTZ camera

Location: Edinburgh, South Australia
Project Description:
The Advanced Vehicle Systems team is developing an autonomic management system for vehicle digital systems. This student project will develop a software interface between a Pan Tilt Zoom (PTZ) camera and the management system based on the Generic Vehicle Architecture (GVA), a vehicle systems standard architecture.
Project Objectives:
1. Create a software interface that allows the camera to be controlled over an intra-vehicle network.
Project Activities:
1. Document how the PTZ camera is controlled 2. Create a software interface (touchpoint) that allows the PTZ camera to be controlled and to stream video over a GVA network. This software should be written with re-use in mind. There should be minimal effort required for it to be used with a different camera; 3. Document how the software could be used to interface with a different device; 4. Document any suggested changes to GVA message types or data model that would improve the use of PTZ cameras over GVA networks; 5. Create a service oriented “touchpoint manager” that will allow sensors of type PTZ camera to be managed based on the services they provide; 6. Document how all developed software works, its applicability the assumptions made in development and constraints; 7. If time permits as a final test of objectives install the PTZ camera on a Ground Rover UGV and demonstrate that its services can be made available to another Ground Rover via the inter-vehicle network; and 8. Deliver final placement presentation.

IEP LD 05: Resilient Position Navigation and Timing for ground rovers

Location: Edinburgh, South Australia

Project Description:

The Advanced Vehicle Systems team is developing an Autonomic Management System for vehicle digital systems. Army vehicles require resilient positioning services in order to operate in current and future environments. Satellite based navigation systems (GNSS) are not always available and few vehicles are equipped with GNSS independent inertial navigation systems. This project looks to explore resilient positioning of ground rovers (robots) using GPS, inertial systems, and observation of landmarks and other friendly ground rovers while exchanging data over an inter-vehicle network.

Project Objectives:

1. Understand the performance capabilities of the different position sensors;
2. Make technical recommendations for future sensors based on cost and performance; and
3. Make architectural recommendations for the integration options for the position based sensors.

Project Activities:

1. Integrate position sensors with the robot control system;
2. Document the integration of the position sensors with the robot control system;
3. Assess the performance of different position sensors for robot position, control and guidance;
4. Report on the performance of different position sensors for robot position, control and guidance;
5. Develop software interface that allows the position sensor to operate with the position service of the vehicle Autonomic Management System;
6. Integrate position sensors with the position service of the vehicle Autonomic Management System;
7. Document the integration of the position sensors with the vehicle Autonomic Management System;
8. Assess the performance of the position service of the vehicle Autonomic Management System using precise robot position as a reference;
9. Report on the performance of the different position sensors of vehicle Autonomic Management System using precise robot position as a reference; and
10. Final placement presentation.

IEP LD 06: Assessing Camouflage effectiveness within a virtual environment

Location: Fishermans Bend, Victoria

Project Description:

The Lelantos capability is an initiative that seeks to create a virtual environment that is capable of visually representing the electromagnetic energy signatures across different bands from both sensor measurements in the field and modelled signatures from computational simulations. The aim is to allow virtual assessment of target signature within an operational environment across a broad spectrum of wavelengths.

Virtual Battle Space (VBS) is a simulation environment developed by Bohemia Interactive Simulations based on a game engine. VBS is being used with varies militaries around the world for training purposes. Existing working within LPP have demonstrated that VBS can be used to represent real world environments and to conduct virtual signature assessment studies.

This project will require the student to work with a game-engine and 3D modelling tools to will generate new virtual environments and models for the Lelantos capability. In additional, the student will also use these developed models to conduct target detection and signature assessment studies aimed at both understanding the validity of the models used and better understanding of target signatures.

Project Objectives:

The aim of this project is threefold:

1. To expand on previous work in this area and expand the virtual environments available as well as to develop a library of models which may be used for future signature assessment;

2. To develop and conduct studies looking at the signature assessment using the virtual environment developed; and

3. Explore new and emerging technologies which may impact the manner in which virtual signature assessment can be conducted.

Project Activities:

1. Developing new environments and creating a library of models of vegetation and targets in the visible, NIR and TIR spectrums;

2. Investigate how hyper spectral sensor data can be incorporated into VBS;

3. A target detection study using the environment and models developed;

4. Investigate technologies, such as VR, AR, eye tracking, that can aid in virtual signature assessment;

5. A report detailing the work conducted in the IEP; and

6. Final placement presentation.

IEP MD 01: Submarine Structural Integrity – Stress-Corrosion Cracking of Submarine Hull Steels

Location: Fishermans Bend, Victoria
Project Description:
It is necessary to assess the Stress-Corrosion-Cracking (SCC) susceptibility of a submarine steel to support the structural integrity of a submarine. In this project, two different material-testing methods (slow strain rate testing and rising-displacement testing) will be used to assess the SCC susceptibility of submarine hull steels. The results of these tests will also facilitate research into the effect of SCC test variables (e.g. electrode potential, test speed). In addition, it will be necessary to conduct post-test examination of SCC specimens, which will involve microscopy (optical and scanning electron microscopy) and metallography.
Project Objectives:
1. Carry out experimental research to gain an increased understanding of SCC susceptibility of submarine hull steels (e.g. interrupted slow-strain-rate-tensile testing, generating material-property data); and 2. Carry out experimental research to gain an increased understanding of SCC test variables (e.g. crosshead speed) in order to optimise the SCC test procedure at DST Group.
Project Activities:
1. Carry out rising-displacement SCC tests; 2. Carry out slow-strain-rate-tensile SCC tests; 3. Examination of SCC specimens using microscopy and metallography; 4. Analysis of SCC test data; 5. Presentation of results from SCC tests and microscopy; 6. Final placement presentation.

IEP MD 02: Adaptive Robotics for Undersea Exploration

Location: Eveleigh, New South Wales
Project Description:
Design, develop and test adaptive behaviours for autonomous (self-driving) underwater vehicles operating in coastal environments. The purpose is to demonstrate and field-test robust machine intelligence for underwater survey and navigation of dangerous, cluttered or rapidly changing near-shore conditions. Behaviours under consideration include obstacle avoidance, target recognition and exploitation of currents or tides exploitation for energy-efficient propulsion.
Project Objectives:
1. Develop a concept of operation for the application of adaptive robotic behaviour to undersea exploration where communications with operators at the sea surface is absent or intermittent. 2. Develop autonomous behaviour for a commercial underwater robot in use with various navies around the world. 3. Test and evaluate autonomous behaviour under relevant operational conditions and demonstrate to target user groups.
Project Activities:
1. Design algorithm for autonomous underwater behaviour and test with desktop simulation (*e.g.*, MATLAB or similar) 2. Transfer autonomous algorithm to robotic middleware (*e.g.*, MOOS) and simulate with robotic 'back-seat driver' on-board computer. If necessary, develop other control software for seamless integration. 3. Bench-test autonomous behaviour under various simulated conditions 4. Field-test autonomous behaviour under various environmental conditions. 5. Workshop autonomous behaviour with target user groups, demonstrate and evaluate its applications to user requirements. 6. Generate a technical report and/or user manual on implementation of the algorithm/behaviour to practical undersea exploration. 7. Final placement presentation

IEP MD 03: Structural Integrity Analysis of a Naval High-Speed Craft

Location: Fishermans Bend, Victoria

Project Description:

Through provision of evidence-based advice and collaboration with Defence and industry partners, the Defence Science and Technology (DST) Group is supporting the sustainment of the Armidale Class Patrol Boats (ACPBs). This includes reducing the cost of ownership and maintaining the operational availability of the fleet.

One aspect of this effort is to obtain and utilise hull monitoring system data, including performing fatigue life analysis. DST Group commissioned such a hull monitoring system onboard an ACPB, HMAS MARYBOROUGH, in May 2015. The evaluation of the fatigue life of an in-service platform enables management of the effects of structural deterioration under fluctuating loads, forms the basis of possible Life-of-Type extension studies, and provides useful information for operational guidance (for example, information on the bridge on the risk of severe wave impacts or "slamming" versus the urgency of the mission, or a slam avoidance tool).

Project Objectives:

1. Improve understanding of the operational profile and structural response of the ACPBs
2. Establish a processed full-scale dataset for fatigue life analysis and verification of numerical tools.
3. Develop a robust operator guidance tool to provide near real-time slam event information

Project Activities:

1. Data processing, signal conditioning, and analysis of hull monitoring system data (strains, accelerations, motions, ship speed)
2. Provision of feedback to direct maintenance of the hull monitoring system
3. Design and prototyping of a bridge-based operator guidance tool (software and hardware) integrated into the existing hull monitoring system
4. Report writing to DST Group standards
5. MATLAB programming
6. Active participation in meetings
7. Final placement presentation

IEP MD 04: Ultimate and Fatigue Strength Assessment of Degraded Surface Structures

Location: Fishermans Bend, Victoria

Project Description:

A naval vessel is complex structure, designed to operate in a safe and efficient manner throughout its useful life (design life). In order to achieve this, a platform is first designed against a set of criteria that determines sufficient safety against failure for a number of structural failure modes such as buckling against extreme loads and fatigue failure for through-life cyclic loads. Furthermore an effective through-life management system for the structure is required to ensure protection against progressive failure modes. In this respect, it is important to understand the actual condition, use, and performance of the platform structure as it changes over time, so that the basis for predictions of remaining useful service life and possible life extensions can be made.

Structural deterioration from corrosion and fatigue cracking is the cause for a significant percentage of naval assets being removed from service. Defence Science and Technology Group is conducting research and collaborating with international partners under The Technical Cooperation Program (TTCP) arrangement to develop robust toolsets and assessment methodologies to assess the structural integrity, safety and survivability of ageing naval platforms through experimental and numerical work.

The Naval Architecture and Platform System Analysis (NAPSA) group within Maritime Division is responsible for this program of work.

Project Objectives:

1. The development and validation of toolsets and methodologies to assess structural integrity, safety and survivability of degraded (ageing) naval platforms.

2. Provide advice on effective maintenance strategies of naval platforms

3. Provide advice on Life of Type and Life of Type Extension of naval platforms

Project Activities:

1. Literature review on ultimate strength of naval ship structures
2. Develop high fidelity Finite Element (FE) models of ship grillages (as built and degraded) and conduct non-linear FE analysis.
3. Develop high fidelity FE models of fatigue joints (as built and degraded) and conduct fatigue assessment
4. Contribute to the round robin comparison of analyses carried out with different toolsets amongst TTCP partners
5. Report writing to DST Group standards
6. Active participation in meetings
7. Final placement presentation

IEP NSID 01: Autonomous Cognitive Computing for Analyst Decision Making

Location: Edinburgh, South Australia

Project Description:

We live in an age of information overload. Dealing with this is one of the great challenges of our age. Our research seeks to address information overload by building a system with the ability to automatically process large volumes of information from a variety of sources such that it is amendable to sophisticated question and answering. Such a system would augment its user's natural cognitive capabilities and minimise burden of information deluge. It would be capable of some of the following:

- receiving general direction
- anticipating information needs
- noticing information gaps
- taking the initiative to fill information gaps; and
- engaging in effective dialogue with humans.

This placement provides the exciting opportunity to work closely with our multi-disciplinary team on a state-of-the-art prototype cognitive computing system.

Project Objectives:

1. Gain a unique experience in an advanced, leading-edge, collaborative R&D environment; and

2. The opportunity also exists to publish on aspects of the work in national and/or international forums.

Project Activities:

According to interest and expertise and in close collaboration with project staff, the candidate would be required to provide a final placement presentation and work on some of the following tasks:

1. Understand user requirements and goals for decision-making;

2. Understand various system inputs; and

3. Final placement presentation.

IEP NSID 02: Image analysis and exploitation using LiDAR point clouds

Location: Edinburgh, South Australia

Project Description:

LiDAR point clouds can be used as another modality in a Multi-source analysis and exploitation framework. The scope of this work would involve exploring and exploiting the LiDAR scan data from aerial imagery in order to identify, recognise and summarise the target objects.

The successful applicant for this position will be required to apply and maintain a NV1 Security Clearance.

Project Objectives:

1. Working with LiDAR point clouds;
2. Developing algorithms and software using MatLAB, Python, C++ on Linux;
3. Developing test suites for analysis; and
4. Report.

Project Activities:

1. Literature review;
2. Algorithm and software development;
3. Experiments and analysis;
4. Reports and other documentation; and
5. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Data analysis;
- Pattern recognition;
- Programming knowledge;
- Proficiency in mathematics;
- Image/Signal processing experience; and
- MatLAB, Python and C++ on Linux.

IEP NSID 03: Small Satellite Ground Station Development

Location: Edinburgh, South Australia
Project Description:
The NSID small satellite team is designing a CubeSat for the Buccaneer mission following the launch of the Buccaneer Risk Mitigation CubSate in early 2017. This IEP project will involve taking the lessons learned from the first CubeSat mission and applying these in the electrical, mechanical and software design of the Buccaneer CubeSat. This work will be conducted in a team environment.
Project Objectives:
1. Contribute to the electrical and mechanical design of spacecraft 2. Contribute to the flight software design and implementation 3. Contribute to the assembly, integration and testing plans
Project Activities:
1. Flight and prototype hardware design 2. Flight software design and development 3. Test and evaluation of porotype systems 4. Mechanical and electrical integration of flight hardware 5. Final placement presentation

WCSD IEP 01: Enhancement of explosive terminal effector via heat treatment process

Location: Edinburgh, South Australia
Project Description:
The project is focused on using annealing and/or other metallurgical processes to improve the material characteristics of an explosive device (effecter). The project will include research, treatment and testing of the explosive effecter with the goal of increasing its performance.
Project Objectives:
1. Develop and demonstrate research skills; 2. Design and implement a rigorous testing regime; and 3. Document results and present findings.
Project Activities:
1. Conduct research into heat treatment processes; 2. Design and conduct test program including material treatment and explosive testing; 3. Analysis of material/grain structure via microscope pre and post treatment; 4. Documentation of results in a final report; and 5. Final placement presentation.
Relevant Research Areas and Desirable Skills:
1. Mechanical / Mechatronic Engineering; and 2. Material Science.

WCSD IEP 02: Gimbal based – remote control camera positioning.

Location: Edinburgh, South Australia

Project Description:

Working under close supervision with electro-optic sensor specialists and using the existing or supplied hardware contribute to the design and implementation of computer controlled gimbal mechanism for remote pointing of an IIR camera (or other sub-system) in a remote location. It would be assumed an existing Ethernet link between the controlling PC and remote equipment.

There are number of aspects of the project:

1. Familiarity with feedback control systems;
2. Software development under MATLAB and C++; and
3. Modelling of electro-mechanical systems.

Project Objectives:

1. Development of the improved capability for trials in remote locations;
2. Development of MATLAB models suitable for generic seeker modelling; and
3. Development of GUI-based controller for the required pointing accuracy.

Project Activities:

1. Development of MATLAB and C++ models of generic gimbal configuration;
2. Implementation of model for the particular configuration required for IIR cameras;
3. Contribute to design review working with EOSP and SES;
4. Design and test of GUI interface;
5. Test the implemented system; and
6. Final placement presentation.

Relevant Research Areas and Desirable Skills:

- Familiarity with feedback control systems;
- Software development under MATLAB and C++; and
- Modelling of electro-mechanical systems.

WCSD IEP 03: Development of Real-time Automatic Target Recognition (ATR) algorithms applicable to Threat Object Detection Systems

Location: Edinburgh, South Australia
Project Description:
Currently a number of technology solutions are used for detection of buried threat objects. However, clutter objects and soil inconsistencies contribute significantly to a high false alarm rate. The aim of this project is to develop real-time advanced ATR and apply them in current and evolving Improvised Explosive Device (IED) detection technology systems including vehicle mounted Ground Penetrating Radar (GPR), Metal Detector (MD) arrays and harmonic radar.
Project Objectives:
1. Enhanced stand-off detection capability of threat objects using multiple sensor data; and 2. Improved threat object detection capability in complex and dynamic environments.
Project Activities:
1. Participate in data collections using different IED detection sensor types; 2. Analysis and pre-processing of experimentally collected data; 3. Development and implementation of concepts for real-time ATR algorithms applicable to multi-sensor data; 4. Evaluate new ATR using multi-sensor data sets provided by the DST Group; 5. Provide a written report detailing the methodologies used in the development of ATR and software package; and 6. Final placement presentation.

WCSD IEP 04: Micro-fragment Target Effects

Location: Edinburgh, South Australia
Project Description:
A requirement exists for an investigation into the explosive focussing of micro-fragments and the effects of these against various targets. It is expected that an experimental program will be undertaken to characterise and optimise the charge geometry to in order to deliver optimum jetting effects. The effects of varying the size of the micro-fragment at various ranges against static and moving targets will be investigated. Equipment to produce the required charge geometries and measure their effects will need to be designed and manufactured during the course of the project. Some computational modelling will also be required. Benefits to DST Group of this project will be a greater understanding of target effects of micro-fragments against a variety of targets. This will feed into a number of projects that WCSD is currently undertaking as well as provide a bank of fundamental knowledge for the future.
Project Objectives:
1. To gain fundamental data on micro-fragment/target interactions; 2. To design optimised micro-fragment charges and investigate their effect on moving and stationary objects; and 3. Conduct computational modelling to better understand the interactions.
Project Activities:
1. Mechanical design of components; 2. Rapid prototyping of components; 3. Liaising with industry to have components manufactured; 4. Finite element modelling of fragment target interactions; 5. Conduct of experiments in the high explosive firing chamber or on field trials; 6. Report on findings in both written and oral forms; and 7. Final placement presentation.

WCSD IEP 05: Combat System Development

Location: Edinburgh, South Australia

Project Description:

The Combat Systems Effectiveness and Analysis (CSEA) group is developing a generic framework to enable the tailored representation of ship combat management systems, air mission systems, land battle management systems and weapons mission planning systems.

The Project will employ a model based systems engineering approach to capture requirements and document software designs for functions to be implemented within that framework.

The Project will also involve the development of software (in C++) to implement those functional elements and integrate them into the framework as a member of the Combat Management System Modelling team.

Project Objectives:

1. Capture requirements for combat system functions;

2. Contribute to the design of software to implement those functions; and

3. Develop software components to implement those functions and integrate them into a broader combat system framework.

Project Activities:

1. Acquire an understanding of the generic combat systems framework architecture and associated modelling and simulation infrastructure;

2. Participate in a Study Team involving analysts, software modellers and other technical subject matter experts as an overarching activity spanning the placement;

3. Engage stakeholders including DST subject matter experts, military personnel, and industry partners to understand the functional requirements of specific combat systems functions;

4. As part of a small team collaboratively develop designs to implement those functions in accordance with the framework architecture, and if needed recommend amendments to the architecture;

5. As part of a small team develop software to implement those functions, integrate them into the framework architecture, and test and document their functionality; and

6. Final placement presentation.

WCSD IEP 06: High speed imaging using SPAD arrays

Location: Edinburgh, South Australia

Project Description:

Working under close supervision with a range of experts in computer/FPGA programming and image processing. Additionally the project requires experimental testing in the laboratory or the field in support of SPAD imagery collection. There are three main facets to this work;

1. Familiarisation with hardware especially Altera FPGA and software as they relate to SPAD array imaging systems and FPGAs for both passive and active applications;

2. Development of software in MatLab and C++. The emphasis will be on high speed imaging;

3. Characterisation of sensor and/or laboratory/field demonstration.

The work package can be tailored to the individual to come up with a suitable subset to be undertaken over the year.

Project Objectives:

1. Upgraded capability of the LADAR real time imaging system including the development of passive alternatives;

2. Upgraded capability of SPAD imaging software tools; and

3. Upgraded capability of the GUI control and data logging system for the LADAR seeker.

Project Activities:

1. Develop the high speed imaging capability in a MatLab & C++ environment and/or other software as appropriate;

2. Develop understanding of the critical parameters in the application of the SPAD sensor technology;

3. Use the MatLab tools to process a series of images collected both actively (i.e. using a laser) and passively. Assess the performance of the sensor in various environments;

4. Display collected imagery in other alternative 3D methods;

5. Characterise sensor and the effect of various parameters in image collection; and

6. Final placement presentation.

WCSD IEP 07: Data Distribution Service Interoperability and Performance

Location: Edinburgh, South Australia

Project Description:

This topic covers the exploration of performance and interoperability of Data Distribution Service (DDS), an industry standard for publish and subscribe software architectures used extensively through the industry. DDS vendors offer highly tuned middleware solutions that can vary in performance depending on how systems are deployed and configured. Interoperability of data published on the wire has been a key advantage for DDS advocates, allowing downstream developers to hypothetically build and integrate complex systems with relative ease using their vendor of choice.

A number of interoperability studies have been run by Object Management Group (OMG) to demonstrate interoperability using the "Shapes Demo", a very limited set of data types and functionality. For operational systems, multi-vendor interoperability and its impact on performance is a large unknown and needs work in a number of areas. This is the purpose of this placement.

Project Objectives:

1. Knowledge and source code to test and evaluate interoperability of multi-vendor DDS for large complex systems;

2. Quantitative analysis and data to substantiate areas of limitation in cross vendor interoperability and performance. Analysis and data will be used as a baseline to evaluate future extensions and enhancements to the DDS standard and its impact on usage of DDS in Defence projects; and

3. Demonstration, reporting and documentation of the process and outcomes of the study.

Project Activities:

1. Generation of a Data Model Interoperability Matrix;

2. Investigation of performance characteristics when various vendors inter-operate;

3. Exploration of Quality of Service criteria and areas of interoperability with QoS;

4. Infrastructure to assist in automated testing and deployment;

5. Consideration of emerging extensions to DDS such as DDS; Security and DDS-X Types; and

6. Final placement presentation.

WCSD IEP 08: Software development for imaging systems

Location: Edinburgh, South Australia

Project Description:

Working under close supervision with a range of experts in computer programming, image processing and experimentation, develop software and models in support of image generation and emulation of real world tracking systems. There are three facets to this work;

- Scene generation using VIRSuite 3 which is based on Unreal engine 4. VIRSuite is under continuing development, additional functionality and representative models are both required.
- Infrared tracking systems use a variety of techniques. These are being ported from legacy software in to MatLab. Both legacy and new/novel tracking techniques will be incorporated.
- The surrogate seeker is a hardware system used to emulate Imaging infrared tracking systems. The hardware is controlled by software developed in-house. This software needs to be upgraded and additional tracking algorithms need to be integrated.

The work package can be tailored to the individual to come up with a suitable subset to be undertaken over the year.

Project Objectives:

1. Upgraded capability of the VIRSuite real time image generation system including the development of target models;

2. Upgraded capability within the ATA toolkit imaging infrared tracker software; and

3. Upgraded capability of the GUI control and data logging system for the surrogate seeker.

Project Activities:

1. Develop a target model and scene for the VIRSuite image generation software. This will include 3D wireframes, surface textures, gaseous objects and earth surface (land/sea);

2. Develop a capability within the VIRSuite code;

3. Use the MatLab tools to process a series of images produced by VIRSuite. Assess the performance of various tracking algorithms on the scene;

4. Add a tracking block to the MatLab image tracking tool kit and possibly to Simulink;

5. Use the surrogate seeker to collect a series of images suitable for testing real time tracking algorithms;

6. Upgrade the of the GUI control and data logging system for the surrogate seeker; and

7. Final placement presentation

WCSD IEP 09: Human Factors of Uninhabited Aerial Vehicles (UAVs) for Surface Ships

Location: Edinburgh, South Australia
Project Description:
The Royal Australian Navy is investigating the use of UAVs for their Surface Fleet. A DST Group-led workshop developed a number of possible concepts of use, and DST Group is exploring these concepts through the use of simulated exercises. The findings from these studies will inform Navy of performance and human implications of these options. The project will require a review of the UAV literature and how UAVs may be used from Navy ships. The project will also develop one or more experiments to investigate the human factors of UAV usage by Navy ships, identify key implications, and make recommendations.
Project Objectives:
1. Identify information and control requirements of personnel using UAVs within RAN operations rooms; and 2. Identify key information to be exchanged between personnel and assess the effectiveness of different methods to exchange that information (e.g. verbal, shared displays, integrated systems).
Project Activities:
1. A literature review of UAV research for employment in surface ships; 2. Development of detailed experiment plan; 3. Work with technical experts in the development of the simulation software to support the experiment; 4. Pilot testing of the experiment and preliminary analysis; 5. Conduct of the experiment; 6. Analyse the data, and write up the findings and recommendations in a report; and 7. Final placement presentation.