Australian Government
Defence

DSTG Summer Vacation Placement Program

2023 - 2024

Proposed Projects

List of Abbreviations

Division	**Abbreviation**
Human and Decision Sciences	HADS
Information Sciences Division	ISD
Platforms Division	PD
Research Technology Operations	RTO
Sensors and Effectors Division	SED

Research Stream	**Abbreviation**
Aerospace / Aeronautical Engineering, Naval Architecture Stream	AAENA
Chemical, Radiological, Biological, Food Sciences Stream	CRBFS
Computer Sciences, IT, Software Engineering, Telecommunications Stream	CSITSET
Electronic / Electrical Engineering Stream	EEE
Materials Science Stream	MS
Mathematics and Physics Stream	MP
Mechanical and Mechatronic Engineering (including Robotics) Stream	MMER
Psychology and Social Sciences Stream	PSS

Project ID	Location	Project Title	Project description	Desirable Skills	AAENA	CRBFS	CSITSET	EEE	MS	MP	MMER	PSS
SVP HADS 01	Edinburgh, South Australia	**Future Weapons - Data Analysis to Identify Performance Assessment Characteristics**	The Future Systems and Concepts Analysis (FSCA) team explores how new technologies and concepts could be applied to give the Australian Defence Force the next capability advantage! FSCA has been investigating how directed energy weapons (i.e. laser weapons) could be used in a military context. Our work requires us to engage with subject matter experts to understand and evolve technologies and the ways we operate them. We use many and varied methods to gather data (including digital simulation), analyse systems, and assess capabilities. This project will explore techniques to develop integrated laser weapon concepts using modelling and simulation tools. The successful applicant would have the opportunity to work with a team of analysts and subject matter experts to generate valuable insights for Defence. This may involve developing an improved simulation model for assessing the military utility of new technologies, or use existing simulation models to assess various elements of integrated systems of interest in order to understand the limitations and opportunities that these new technologies offer.	• Mathematical modelling and data analysis skills • Experience with Python or similar coding languages • Effective communication skills			X	x		x		
SVP HADS 02	Canberra, ACT	**Quantitative Understanding of Information Warfare: System-Dynamics of the Two-Step Model**	The two-step model is a simple sociological concept which explains how information derived from primary sources can be used to influence an agent's perspective. Using a system-dynamics approach to model information-flow and decision-making, this project seeks to obtain quantitative understanding around the key parameters which affect model behaviour, and draw parallels with real-life events.	• Solid understanding of coupled/networked ordinary differential equations, ideally of the non-linear variety • Ability to code in either a mathematical software package like Mathematica, or able to perform numerical integration via Python • Good verbal and excellent writing skills • Awareness of sociological concepts would be a bonus.			X			X		X
SVP ISD 01	Edinburgh, South Australia	**Fuzzing 64bit ARM Firmware with EMUX Emulation.**	The EMUX Firmware Emulation Framework is a collection of scripts and Linux system components (e.g., compiled kernels, file systems, etc.) that are used with QEMU to emulate Linux-based IoT devices to facilitate security research by virtualising as much as the physical device as possible. The framework currently supports both ARM and MIPS architectures. This project will investigate integrating 64bit ARM (Aarch64) support into the EMUX framework to emulate Aarch64/Linux-based IoT devices. This will include creating emulated device instances of unsupported devices for the EMUX framework which can then be integrated with fuzzing tools (e.g. AFL++).	• Software Development Skills (Python / Bash / C) • General IT, Embedded Systems / IoT Knowledge • Good verbal and writing skills.			X					
SVP ISD 02	Edinburgh, South Australia	**Knowledge Systems For Computer Network Data**	In operations like computer network management or White-hat hacking, an operator collects a large volume of complex network data that is challenging to analyse. Due to the interconnected nature of networked devices, such data is best stored as a graph of related entities rather than in tabular form. However, visualising and interpreting graph databases poses unique challenges to analysts who are not necessarily database experts, especially when the possibility for incomplete or erroneous data must be taken into account. The purpose of this summer project is to assist in the development of tools that can be used to interpret and understand complex network data. Tasks can be tailored to foster different skills depending on the applicant's interests, including software development in user interfaces and visual analysis, and applied research of statistical and machine learning methodologies for smart inferencing over the data.	• Computer Science (e.g. Python programming) • Data Science (statistics and machine learning • **Optional**: Mathematics (e.g. graph theory)			X	X		X		
SVP ISD 03	Edinburgh, South Australia	**Connecting Users - Determining Who is Talking to Who Through Timestamps**	Within the Information Sciences Division at DSTG, Communication Signal Processing (CSP) is focus on analysing radio frequency (RF) spectrum to find RF usage patterns and information about RF transmitters. CSP is looking into messages transmitted over Wi-Fi where only the senders address can be observed. We want to determine if we can use the timing of the messages alone to see which users are messaging each other. This will be done through the use of graph theory and machine learning.	• **Essential**: Software Development Skills (Python) • General IT systems knowledge • Graph theory knowledge • Good verbal and writing skills.			X			X		

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SVP ISD 04	Lot 14 Adelaide, South Australia	**Multi-Agent Communication for Autonomous Cyber Defence**	The Autonomous Cyber Operations (ACO) discipline performs research into how Artificial Intelligence (AI) may be leveraged to defend computer networks. This autonomous defence is important because it is not always possible for human cyber security operators to actively defend every aspect of a network at all times. A system of multiple autonomous defenders can scale to large networks and work cooperatively prevent a major cyber security incident. Inspired by advances such as AlphaStar and OpenAI Five, we are currently researching how to use Multi-Agent Deep Reinforcement Learning to train a system of agents capable of autonomous cyber defence. A key aspect of multi-agent systems is the ability for these agents to communicate efficiently and effectively with each other. Students working on this project will learn how to train AI agents using Multi-Agent Deep Reinforcement Learning, build valuable programming expertise, and contribute to cutting-edge research into multi-agent communications systems by: • Helping to implement a state-of-the-art multi-agent communication algorithm that can detect a cyber-attack and evict an attacker from the network • Evaluating the effectiveness of these multi-agent communications systems in simulation and real computer networks • Presenting research findings to the ACO team, and wider Defence community	• Software Development including familiarity with tools such as Python and Git • Machine Learning with tools such as PyTorch • Good verbal and writing skills.			X					
SVP ISD 05	Edinburgh, South Australia	**Machine Learning for Software Vulnerability Detection**	Software vulnerabilities persist. As the rate of software uptake continues to increase, the demand for more effective vulnerability detection techniques grows. State-of-the-art machine learning (ML) techniques offer an exciting avenue for exploring new ways of detecting software vulnerabilities. This project will explore methods used in literature on both source code and binary code datasets and determine whether ML techniques are usefully transferrable between these data types with clever adaptation. Your work will contribute to a larger body of research on how to increase the speed of vulnerability detection and analysis, in support of the people regularly evaluating the security of real-world programs.	• Software development (Python preferred, C/Java beneficial) • Familiarity with machine learning or statistical approaches • Familiarity with common software vulnerabilities • Familiarity with assembly code and compiler operation/techniques • Basics of data science • Good writing and communication skills			X					
SVP ISD 06	Lot 14 Adelaide, South Australia / Edinburgh, South Australia	**Profiling Network Connections for Cyber Situational Awareness**	Modern networks often have huge numbers of devices, which provide various capabilities to users of those networks. For a military operator connecting to a new network for the first time, getting a baseline understanding of a large and complex network can be a significant challenge. In this project, you will use traffic captured from an organisational network to determine if it is possible to identify/cluster/classify the types of connections between IPs based on flow metadata and statistical properties of the packets sent. You will then attempt to use this information to infer the structure and dependencies present in the network.	• Proficiency programming in Python • Skill and experience in, or a desire to learn about, data science and cyber security.			X	X			X	
SVP ISD 07	Lot 14 Adelaide, South Australia / Edinburgh, South Australia	**Predicting Future Network Traffic of Unencrypted Protocols Using NLP**	Large Language Models (LLMs) have seen amazing advances recently with tools like ChatGPT and GPT-4 being publicly usable. These models have shown the ability of large deep-learning models to learn complex and abstract relationships in language. In this project, you will consider network protocols as a new (and likely unknown) language to model with deep-learning. You will research how to effectively and efficiently train a model on large amounts of network traffic. You will then evaluate generated traffic based on protocol compliance and reasonableness based on the contextual state of the system.	• Proficiency programming in Python • Skill and experience in, or a desire to learn about, data science and cyber security.			X	X			X	
SVP ISD 08	University of Queensland	**From Binaries to Program Verification**	This project concerns automated program analysis conducted on binary code. Its aim is to integrate two major components of a tool chain that have been developed by the group to date. It involves in particular, a new, state-of-the-art decompiler which disassembles and lifts (aarch64) binaries into an intermediate representation suitable for verification, and an analysis framework for automatically conducting the verification. The task of the project is to integrate the decompiler with the analysis framework to build a complete tool chain for binary analysis. This will involve data format transformations and program transformations. The participant will work alongside a team of researchers working on automated program verification.	• Software development in Scala/Java • Familiarity with assembly code • Good communication skills.			X					

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SVP ISD 09	Edinburgh, South Australia	**Search Action Planning**	Researchers in the Information Sciences Division at DSTG are interested in exploring decision aids for search actions. For example, a Naval task group typically has a courses of action pre-defined for a mission, but how can we support sailors to update those decisions when new information appears. This project will look at extending an existing search area visualisation tool to incorporate mission planning and account for unexpected eventualities. We are interested in the application of knowledge graphs and how to best represent timeline divergence for planning purposes.	• Mathematics • Software engineering and development skills • Data science • Ability to work in teams • Good communication skills	X		X	X		X	X	X
SVP ISD 10	Edinburgh, South Australia	**Analysis of Multicore Fibre For Imaging**	Coherent fibre bundles offer an alternative to traditional free space optical systems and have seen commercial use in endoscopic imaging systems as they offer the ability to access confined spaces that would be difficult with traditional imaging systems. Inter-core coupling in an imaging fibre bundle can reduce the resolution of the fibre-based imaging systems. This project will focus on measuring, analysing, and quantifying the inter-core coupling in commercial coherent image fibre. The project will present an exciting and hands-on experience in optical experimentation and scientific imaging techniques for the candidate.	• General optics lab experience. • Programming languages (e.g., Python, Matlab) • General IT systems knowledge. • Ability to work in teams. • Good verbal and writing skills.				X		X	X	
SVP ISD 11	Edinburgh, South Australia	**Adversarial Multi-Domain Behaviour Analysis**	Within the Information Sciences Division at DSTG, the Adversarial Multi-Domain Behaviour Analysis (AMBA) project is developing techniques to analyse data from multiple sources to help better understand the environment within which military activities occur. This requires natural language processing (NLP) technologies to automate, as much as is possible, the extraction of details about events described in operational reports and encoding those details in terms of domain ontologies. This task involves the evaluation of some NLP technologies applied to representative samples of such reports.	• **Essential:** Software Development Skills (Python, Java) • **Desirable:** NLP fundamentals • Strong IT systems knowledge • Good verbal and writing skills.			X					
SVP PD 01	Fishermans Bend, Victoria	**Sound Propagation Through Air-Filled Ducts**	The study of sound propagation and noise attenuation through ducted systems is important in many real-life applications, such as internal combustion engine exhausts, industrial exhausts, water-supply pipe networks, and air-conditioning systems. The research will involve investigating the sound propagation through air-filled ducts with different noise attenuation technologies. The research comprises of a literature review on existing noise attenuation technologies, numerical modelling with FEM using ANSYS Mechanical or COMSOL, and experimental testing, with an existing exhaust system. The work would also involve investigating methods in improving experimental transmission loss measurements by considering different end conditions at the outlet and different noise source coupling geometries.	• Numerical modelling and data analysis using Matlab • Finite element modelling of structural vibration and/or acoustics • Vibration and/or acoustic measurements • Ability to work independently and in small teams • Good communications skills.	X			X		X	X	
SVP PD 02	Fishermans Bend, Victoria	**Lower Order Design Techniques for Maritime Propellers**	Design and analysis techniques for maritime propellers are a key component of the work area of the Hydroacoustics STC within Platforms Division. Modern maritime propulsors can be designed relatively quickly given sufficient computational resources. However, given the finite nature of computational resources and the sheer number of projects competing for these resources, it is necessary to develop simplified tools to handle the early stages of design. The goal of this project is to investigate available low-resource open source propeller design tools, and/or develop our own tools to handle various stages of the design process. The exact scope of the project can be tailored to the student's existing skills or interests.	• Python and/or MATLAB experience, background in physics/mathematics, FEA and/or CFD optional, an interest in propellers and propulsion.	X		X			X	X	
SVP PD 03	Fishermans Bend, Victoria	**Bond Durability of Hybrid Material Designs for Naval Platforms**	The benefits of composite materials over traditional materials, such as steel and aluminium, are well known. However, their application in ship hull and superstructure has been limited. A key benefit of a composite superstructure is lowering the centre of gravity, resulting in a more stable platform. The combination of composite and metal (hybrid) designs is often required, and this involves using adhesive bonding to join composite components to other parts of the assemblies. Under prolonged exposure to the sun, the surface temperatures of superstructures can reach up to 75 ^{o}C. Under such conditions, the different materials of dissimilar coefficients of thermal expansion will experience temperature gradients and thermally induced strains. Consequently, this can possibly degrade and lead to adhesive debonding.	• Composites manufacturing • Mechanical testing • Instrumentation and data analysis • Hands on, working in laboratory • Working in teams • Good verbal and writing skills	X				x		X	

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			The aim of this project is to characterise the thermal and mechanical performance of an adhesive bonded multi-material joints to better understand the thermal strains evolution and durability of such designs.									
SVP PD 04	Fishermans Bend, Victoria	**Exploiting hindcast/nowcast data from large datasets**	Naval platforms are often subjected to extreme weather conditions which induce extreme motions and loads on the ship structures, therefore, quantifying the sea conditions experienced by vessels is important for their calculation. This project will involve the creating of a software tool that easily be used to extract hindcast/nowcast data given location data such as GPS.	• **Essential:** Previous experience programming in Python/R/C++/JS • Familiarity working with Linux based servers and network protocols • Ability to collaborate and work across multiple teams	X		X	X		X	X	
SVP PD 05	Fishermans Bend, Victoria	**3D Digital Image Correlation (DIC) Tool – Enhancements for Open-Source DIC Package**	The Naval Platform Survivability group within the Platforms Division at DSTG conducts vulnerability assessment of maritime platforms and related materials using a variety of experimental and computational techniques. Digital Image Correlation (DIC) is amongst the emerging tools used for non-contact assessment of various materials under extreme loads. This project will focus on the enhancement of existing open-source DIC packages and their integration into existing Python toolsets.	• **Essential**: Software Development Skills (Python) • Knowledge of MATLAB – Desirable • General IT systems knowledge • Ability to work in teams • Good verbal and writing skills.			X	X			X	
SVP PD 06	Edinburgh, South Australia	**Distributed Task Allocation in ISREW Applications**	A focus of the Systems Integration and Tactical Coordination (SITN) team at DSTG is research and development of techniques for distributed decision making between Robotics and Autonomous Systems (RAS) utilised by Defence. A key problem in this context is the allocation of tasks to robots, i.e. the Multi-Robot Task Allocation (MRTA) problem. Distributed solutions to this problem are highly relevant for military RAS where central computers are not feasible and contextual information is not easily shared. The SITN group is considering the MRTA problem in terms of Intelligence, Surveillance, Reconnaissance and Electronic Warfare (ISREW) applications where mobile robots must dynamically position themselves on the battlefield in order to provide ISREW sensing and effecting capabilities in the area surrounding key assets. The aim of this project is to develop a simulation environment in order to study distributed solutions to the MRTA problem in ISREW applications as described, and to investigate, implement and analyse distributed algorithms to solve this problem.	• **Desirable**: Software Development Skills (Python) • Ability to work in teams • Good verbal and writing skills.			X	X		X	X	
SVP PD 07	Edinburgh, South Australia	**Autonomous UAV Placement for Tactical ISR**	Within the Systems Integration and Tactical Coordination (SITN) team we have developed algorithms for determining the optimal placement of sensors in a military environment. The goal is to use a range of static and mobile sensors to detect threats, while maintaining a connected communication network. This project will focus on the motion of quad copter style UAVs which may hold sensors, communication relays, or both. The selected student will aim to implement software for autonomously deploying and moving UAVs to complete sensor networks based on the current algorithms. This project intends to focus on software and simulation, however may have scope for hardware trials.	• **Essential:** Programming (Python) or software development • Good written communication skills • Ability to understand requirements and work independently • Any experience with ArduPilot, Mavlink, or UAVs would be significant bonus.			X					
SVP RTO 01	Edinburgh, South Australia	**RMS-01 FlatSat Prototyping Model**	Research Engineering is supporting the Resilient Multi-Mission Space program, through both design architecture and technical sub-system delivery. This particular project is focussed on the development of a Flat-Sat prototyping bed of the RMS-01 Payload, to allow for engineering development, simulation, testing, and verification of the payload architecture and sub-systems.	• Embedded Systems. • General IT systems knowledge. • Hosted software programming.			X	X				
SVP SED 01	Edinburgh, South Australia	**Characterization of Solid Fuel Gas Generator Exhaust for Rotating Detonation Engines (RDEs)**	The performance of rotating detonation engines is heavily influenced by the composition of the exhaust products generated by solid fuel gas generators. In this research project, students will conduct a series of experiments to characterize the exhaust of solid fuel gas generator fuels as a function of pressure and grain formulation. Fuel samples will be ignited in a closed vessel, and the resulting gases will be collected for further analysis using a residual gas analyser. As part of this research project, students will have the opportunity to:	• Strong academic background in relevant fields such as chemistry, mechanical engineering, or combustion science • Familiarity with laboratory techniques and safety protocols • Basic knowledge of thermodynamics and combustion processes		X	X					

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			• Gain hands-on experience in experimental design and execution • Learn and apply laboratory techniques for fuel sample ignition and gas collection • Analyse and interpret data obtained from gas composition analysis • Collaborate with researchers to identify trends and correlations • Contribute to the development of optimization strategies for enhancing RDE performance.	• Analytical skills for data interpretation and problem-solving • Excellent communication and teamwork abilities.								
SVP SED 02	Fishermans Bend, Victoria	**Fieldable Biological Identification**	Within the Sensors and Effectors Division at DSTG, the Test & Evaluation of fieldable detection technology is a focus. Defence requires fieldable systems for the identification of biological organisms. The objective of this project will be to determine the optimal parameters for microorganism growth and subsequent analysis for a fieldable identification technology. These parameters will be incorporated in methods that will be documented and incorporated into the Quality System employed in the laboratory. The successful applicant will be trained in the culture of PC1 (risk group 1) organisms including plating the organisms on agarose, harvesting and analysing single colonies using a MALDI Biotyper (MBT) microbial identification system.	• Experience working with microorganisms at PC1 laboratory conditions • Familiarity with the principles of mass spectrometry • Attention to detail and process • Ability to work in teams • Good verbal and writing skills		X	X					
SVP SED 03	Edinburgh, South Australia	**Antenna Testing and Results Analysis: Minimising Gap between Simulation Model and Prototype**	S-parameters and farfield measurement for antennas and antenna array. Analyse the test results and find the gap between the prototyped elements and simulation model. Participate in other activities organised by the team (experiments, trials, etc.). Deliver a report on the test results and present the results to the team. Working in an R&D environment, hands on experience on testing the prototype and verify against requirements. Develop skills in RF test equipment, including the use of Network Analyser, Spectrum Analyser etc.	• Knowledge on RF testing equipment. • Ability to work in teams. • Willingness to participate in trials. • Good verbal and writing skills • RF Engineering				X				
SVP SED 04	Edinburgh, South Australia	**Improved Signal Processing for Phased Array Surveillance Radar Systems**	Our ADF needs to be able to detect and track a wide range of targets within contested and congested operating environments. DSTG's Resilient Radar Systems group conceives and develops data processing techniques to improve the performance of the radar systems that contribute to this need. This project will focus on the use of simulated airborne phased-array radar data to research and develop new ways to detect targets, measure their position, and suppress unwanted interference. For the interested student, there will also be an opportunity to operate DSTG's ground-based passive radar system and develop improvements to its angle estimation procedure.	• Electronic Engineering, Physics, Applied Maths, or Statistics at 1st year University level or higher • Software development skills in Matlab, Python, or similar numerical programming language • Experience with any kind of statistical signal processing helpful, but not essential • Ability to work in teams • Good verbal and writing skills.			X	X		X		
SVP SED 05	Edinburgh, South Australia	**Multistatic Radar Hardware Development and Testing**	Multistatic radar uses multiple transmit/receive pairs to enhance detection performance over conventional radar. DSTG is conducting research, laboratory and field trials of this technology using Software Defined Radios which use Field Programmable Gate Arrays (FPGAs). This project includes a range of activities, including FPGA programming, RF hardware characterisation (phase noise measurement), field trials and modelling and simulation. The specific activities will be determined by the status of the research project at commencement and the skills and interests of the applicant.	• FPGA programming, ideally using LabVIEW (highly desirable) • RF systems • Coding and data analysis in Matlab • Ability to work in teams • Willingness to participate in field trials • Strong verbal and written communication skills.	X			X		X		
SVP SED 06	Edinburgh, South Australia	**Radio Frequency Measurements**	Introduce the university student to RF measurement techniques through the use of a range of RF instrumentation and facilities such as an anechoic chamber. Measurements will include: measurement of amplifier 1 dB compression point, RF filter characteristics, antenna pattern, radar cross-section and S parameters measurements. Through these exercises they will be able to gain an appreciation of the necessary elemental skills required in any type of RF research environment.	• Basic RF measurements • Software Development Skills (Matlab) • Ability to work in teams • Willingness to participate in Field Trials • Good verbal and writing skills.				X				