Australian Institute of Sport

Research Channels

Submission Guidelines

*We, as Australians, expect our athletes to perform at a level matching or exceeding the world's best athletes. For our athletes to achieve this, they need to know they have the best preparation and equipment in the world. The AIS is fully committed to supply these young Australians with, not only technology equal to their competitors, but a with technology advantage. Australia is small in terms of population and, in many cases, with smaller investment in sport, but our natural strengths lie in ingenuity, passion and practical application to solve problems. The world of sport research has moved a long way since the 1980s with research projects going from single researcher pursuits, to multi-skilled teams from a number of Universities, channeling cutting edge technology into sport for fast results in a high-profile endeavour. We, at the AIS, are implementing a new research agenda which will focus on '**research channels'** that will hopefully lead to success defining technologies on or over the current horizon. By funneling the research in this way, we will provide a catalyst to enjoin larger areas of the Australian research community, and generate larger results with larger teams. Our five year vision is to place Australian Sport Research ahead of our competitors in a number of key fields, and translate this advantage onto the courts, tracks, pools and fields of our athletes. I hope you will join us in providing Australia's athletes with the best in the world and along the way build a technology eco-system that will yield much broader advantages for our country.*

– Ian Burns, Deputy Director of AIS Applied Technology and Innovation.

Research Channels – What are they, and how do they get decided?

‘Research Channels’ are essentially broad topics that have been selected by the AIS Expert Panel as offering fertile ground to develop competitive advantage for Australian high performance athletes and coaches.

A Research Channel will be comprised of a variety of projects seeking to explore different avenues of the research channel topic. A project could be an independent study, or it could be connected to other projects within the research channel. Some projects may also be dedicated to specific sports outcomes, while others will accrue benefits to a variety of sports.

Importantly, Research Channels will be set up to engage with PhD students. A tangible outcome from these Research Channels will be a new generation of ‘technologists’ able to apply their skills to high performance sport.

What are the first two Research Channels?

The first two Research Channels selected by the AIS Expert Panel are:

- Computational Fluid Dynamics
- Generative Artificial Intelligence

Computational Fluid Dynamics – Guiding Principles

In very broad terms, numerical simulation, specifically CFD, provides a virtual environment that can assist the athlete, the coach, and members of the broader community working in applied sports science and engineering, in improving understanding of flow physics, improving performance prediction, and optimizing performance within the context of sports where fluid mechanics significantly impacts performance.

Several examples of such sports are; swimming, rowing, cycling, sailing, and even archery, where prediction of aerodynamics of arrow projectiles may be nontrivial. Also, in sports such as rowing, cycling, and sailing, numerically the problem needs to be viewed as a two-way fluid flow and structure interaction between the athlete and machine since the latter contributes significantly to overall performance.

This research channel seeks to advance emerging techniques in applied CFD with the intent that application of such methods to problems in sports cited above will lead to improved competitive advantage.

The CFD topics that are of interest are:

1. Application of DES/VLES and LBM turbulence modelling to sports problems where use of RANS-based methods have not produced aero/hydrodynamic load predictions of acceptable accuracy.

2. Use of machine learning and optimization to derive turbulence model closures based on available or proposed measurements specific to a given sport.

3. Use of wind tunnel and field measured data in CFD simulation initial and boundary conditions; specifically the development and application of sparse data fitting algorithms in this framework

4. Development and application of uncertainty quantification (UQ) CFD models, based on polynomial chaos, in sport-related CFD simulations

5. Development and application of multi-objective adjoint and inverse methods to sports-related design problems. In case of inverse methods, application of force-based rather than pressure based inverse methods for shape design are of interest.

6. Direct, rather than statistical, incorporation of the environmental (weather) factors into sport-specific CFD simulations.

7. Extending the scope of fluid-structure interaction problems, including athlete kinematics in the numerical simulations. Such an effort may involve the application of photogrammetry and motion measurement techniques to accurately record the required kinematics for application into CFD analysis.

It is anticipated that researchers pursuing any of the above topics will make use of High Performance Computing (HPC) resources.

Proposals are invited for this research channel in the areas noted. The proposal should describe and explain in the context of which sport(s) and which problem will the research be carried out.

AIS

SPORTAUS

Generative Artificial Intelligence – Guiding Principles

Deep Learning and Artificial Intelligence (AI) are technical frontiers that allow non-invasive measurement and analysis of key competitors from other nations, as well as measurement of the external load of athletes in their daily training environments.

Computer vision technologies such as player tracking and pose analysis permit the non-invasive measurement of actions, and there is competitive advantage in the performance intelligence that can be derived from these technologies.

While “supervised” deep learning and AI technologies drive these human analysis problems, new technologies are emerging in generative modelling which may propel high performance sport in Australia to a new level.

Generative models demonstrate the capacity to uncover new ideas and concepts that may lead to competitive advantages in sport. This research channel aims to support work that will explore these new opportunities to exploit emerging technologies. Current examples of generative models include Generative Adversarial Networks (GANs), and reinforcement networks. GANs learn a data distribution with “unsupervised” learning techniques in such a way that it is possible generate new data points, conditioned on some criteria, that are representative of the original data. This method has been used with great success to generate high resolution images that are new, in the sense that they are “learned” from an original set of images, but are previously unseen and do not exist in the original data distribution.

Reinforcement learning is another example of generative models, where the algorithm explores a range of candidate policies with regard to a problem. The model discovers the best course of action for a given scenario, and in recent examples, reinforcement learning algorithms have developed above-human competence in computer games, and complex strategy-based board games. It is the nature of those examples that the AI has been found to “discover” novel approaches to game problems.

These methods have not been widely applied to high performance sport, and there is a potential for important competitive advantage in being the first to exploit the concept of *strategy proposals*, where generative models are used to propose new strategic and tactical ideas in domains such as (but not constrained to) team sports.

Consider *in-silica* simulations in pacing events such as distance swimming events, where an AI “learns” the performance parameters of a swimmer, in the context of the predicted performances of other competitors. In this scenario, the AI could be used by a coach to propose and simulate various pacing and energy conservation strategies.

Furthermore, consider an AI that is given a set of team sport game conditions, where the coach may wish to achieve a particular strategic objective (to deliver the ball to a certain location under certain conditions, for instance). A generative AI could be used to simulate and explore possible solutions to this problem, and make strategy proposals to the coach that are considered likely to maximise the chances of sporting success.

Research proposals are invited for this research channel, where the aims of the research are to improve our understanding of generative AI models, and to develop technology to provide coaches with strategy proposals that could be ground breaking within their sports.

How will Research Channels be progressed?

The AIS is seeking to partner with organisations who have high performance capabilities in these two Research Channels. The nature of these capabilities may be very specific in an element of the Research Channel, or more broad, covering a range of areas.

The submission process, outlined here, will bring visibility to the AIS Expert Panel of the capabilities within the Australian research and development ecosystem.

As a result of this process, the AIS will develop a collaborative environment and establish projects that will deliver outcomes in the 3-5 year timeframe.

It is important that the AIS is not viewed as a ‘funding agency’. Rather, the AIS is a collaborative partner that will work within the newly created networks, and be accountable like other partners to deliver outcomes to the Australian high performance system.

What criteria will the AIS use to decide which submissions are successful?

The AIS Expert Panel will review submissions with the follow criteria:

- Does the Project being proposed meet the Research Channel Guiding Principles?
- Is there evidence of collaboration being proposed, both internally within the organisation, and externally?
- Does the project offer possibilities in generating competitive advantage for Australia high performance sport?
- Is there a likely outcome in the 3-5 year timeframe?
- Does the proposal offer benefits across multiple sports?
- Is there evidence of excellent project management procedures?
- Does the submission offer capability enhancement to the Australian Sport Network including products, services and people?

What to do next?

1. Submissions for Research Channels are due by 12pm AEST on Friday 22nd February 2019.
2. The AIS is available to answer questions, teleconference or visit organisations to provide more information. Reach out initially, by emailing Tim Kelly (AIS R&D Manager) via email: tim.kelly@ausport.gov.au
3. We encourage collaboration with ‘value add’ partners including National Sporting Organisations, State Institutes and Academies of Sport, other research organisations and other industry partners. We are very focussed on optimal and practical outcomes, so any partners that bring the delivery of outcomes to the ‘supply chain’ are encouraged.
4. As the development of PhD students is an important part of our strategy, we would encourage early conversations regarding either new or existing PhD students who may be engaged for the purposes of delivering on projects.

For further information, or to have a chat about submissions, please contact Tim Kelly via email: tim.kelly@ausport.gov.au

SportAUS.gov.au

@sportaustralia
@SportAUS
Sport Australia
Sport Australia
@SportAUS
@australian_institute_of_sport