## PROJECT DETAILS

### Project Title

“Mechanical & Control engineering Research”. Research and development of new concepts related to the electronic control of hydraulic valve system components applicable to a wide ranging applications.

### Project Summary

Hydreco Hydraulics (http://www.hydreco.com/), based in Poole, is a leading UK hydraulic pump, motor, valve, and control systems manufacturer. Hydreco's products power a whole range of civil and commercial vehicles all around the world. They have companies in 6 continents and trade globally. The products designed and manufactured by Hydreco Hydraulics are discrete components which form part of a hydraulic circuit, which uses liquid fluid power to do simple work and provide a mechanical advantage. For the hydraulic fluid to do work, oil must flow at high pressure from a pump, through a control valve, to an actuator, then return to a reservoir.

To remain competitive and to maintain their current market position Hydreco Hydraulics has proposed a new Control Valve System that can result in a major technological leap in control system technology. Hydreco intends to collaborate with the Engineering and Design research centre within the Faculty of Science and Technology at Bournemouth University (BU) in order investigate and evaluate the potential benefits of a new design of hydraulic valve.

The aim of this research is to investigate simulate and develop a new control system for the next generation of their new hydraulic valve system that relies on metering and electronic servo drives instead of mechanical drives. The overall aim of the research is to reduce the complexity of the current commercially available and manually controlled hydraulic valve systems in order to improve efficiency and reliability while reducing maintenance cost and. This in turn will reduce power consumption hence significantly reducing emission and power consumption while improving fuel economy or consumption rate. This project proposal mainly focuses on the design of the electronic metering and control element of this new valve design. A parallel project is well underway that is finalising the design and development of this new Valve system.

An initial review of the current state of the art in hydraulic valve design has revealed that it has become increasingly important to develop more efficient hydraulic valve circuits, without compromising their functionality and performance. More efficient and active valve control system can better limit or reduce the emission of greenhouse gasses in order to meet new target guidelines on fuel consumption, reduction in emission and cost (Borghia et al. 2014; Huova et al. 2010; Williamson et al. 2008). Bullough et al. (2008) also speculated that the advances in simulation of computational fluid dynamics and controls systems/algorithms can enable the pre-prototype simulation of smart fluid based control devices to be contemplated or validated. In conclusion, there is a clear requirement for this research driven not only by the company but also by tightened government legislation.


### Academic Impact
This research will underpin Science, Technology, Engineering and Maths (STEM) at BU. STEM is currently promoted by the new formed Faculty of Science and Technology in BU. The proposed investigation into the new generation of hydraulic drive and control system, plus the underlying scientific and technological development should directly impact the development of an industrially informed MEng and Mechanical engineering degrees that are currently being developed at BU. It will also help to secure the future of science and engineering education in BU. These engineering courses have a strong link with our world famous design courses. Research of this calibre can challenge BU academics and will help us to expand our depth and breadth of knowledge and to remain academically up-to-date and industrially informed. On the practical side the proposed system should result in creating a simpler, cheaper, more robust and reliable drive and control systems. This is a fundamental piece of research that will help to further develop the infrastructure needed to push the STEM agenda forward. This challenging research will bring together a multi-disciplinary group of BU scientists and engineers from both University and industry to work together on fundamentals of applied research that has a strong functional outcome. Research will also result in a substantial number of new publications that is needed for the next research assessment exercise. It can also help us to develop the new generation of mechanical engineering degrees that are more informed by research and better aligned with engineering professions as whole.

Societal Impact

High profile research such as this and is collaboration with an international organisation, such as Hydreco, will raise BU research profile in areas of advanced engineering and technology. With the help from BU academics a relatively small but key UK industry can lead and remain competitive in the world market while meeting all the current and future legislation and demands. It will provide an efficient and sustainable research infrastructure where industry and academia work and complement each other. The functional outcome of such collaboration can be in many forms ranging from the development of new scientists or engineers to investigating new and strategic area of technology that can lead to new product designs or major technological know-how. Most importantly, it allows medium sized companies to conduct high level research at a low to moderate costs which allows them to be more ambitious and have more flexibility when being creative. It minimises their cost of research and development and in return it will help BU staff to remain research active and to keep in touch with the needs of industries. Financial security of these SME’s through research and development of new product with generate more employment and with it financial prosperity as well as job security that will also help the local economies. It will also engage SME with Universities that are best place for Knowledge and technology transfer to take place between academia and industry. The success and competitiveness of SMEs directly affect local economies. On a global scale a Hybrid new systems that saves fuel while delivering the same performance must be good because it reduces pollution to the environment. Rapid growth in the 3rd world economies means that the demand for hydraulic drive machine is going to remain high and this project will help to develop more efficient and cleaner systems which has a long term global impact.

Training Opportunities

BU’s Graduate School provides the infrastructure to promote excellence in postgraduate research to enhance the researcher’s experience, including generic and employability skills training, providing opportunities to engage with researchers from other Academic Schools or from relevant industries. Postgraduate researcher will be encouraged to participate in relevant training by taking some prerequisite modules, such as, research methods. The Faculty of Science and Technology is very active in research and collaborative work with national and international institutions and has an entrepreneurial culture with many student projects/research ideas being commercialised. The DSRC is actively participating in the Biomechanical and composite engineering related research. It has links to other universities, hospitals and companies. Such collaboration opens up many new possibilities of extensive applied mechanical engineering research. The student will be encouraged to participate/network in all BU activities, visit sites and participate in creation of publications and attending conferences, etc.

SUPERVISORY TEAM & RESEARCH ENVIRONMENT

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<tr>
<th>First supervisor</th>
<th>Prof. S. Noroozi</th>
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<td>Additional supervisors</td>
<td>Philip Godfrey</td>
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### Recent publications by supervisors relevant to this project

1. **Improvements in the accuracy of an Inverse Problem Engine's output for the prediction of below-knee prosthetic socket interfacial loads**

2. **Static and dynamic pressure prediction for prosthetic socket fitting assessment utilising an inverse problem approach**

3. **Dupac, M. and Furley, G., 2012. Improving pump efficiency by modifying the size and shape of the anti pre-rotation vane.**
   - Transactions of FAME NA, 36 (1), 45-54

4. **Decoupled aerodynamic and structural design of wind turbine adaptive blades.**

5. **Combined analytical/FEA-based coupled aero structure simulation of a wind turbine with bend–twist adaptive blades**

6. **Application of combined analytical/FEA coupled aero-structure simulation in design of wind turbine adaptive blades**

7. **WTAB, a computer program for predicting the performance of horizontal axis wind turbines with adaptive blades**

8. **Efficient meshing of a wind turbine blade using force adaptive mesh sizing functions**

### INFORMAL ENQUIRIES

To discuss this opportunity further, please contact Professor Siamak Noroozi via email: snoroozi@bournemouth.ac.uk

### ELIGIBILITY CRITERIA

All Candidates must satisfy the University's minimum doctoral entry criteria for studentships of an honours degree at Upper Second Class (2:1) and/or an appropriate Masters degree. An IELTS (Academic) score of 6.5 minimum (or equivalent) is essential for candidates for whom English is not their first language.

### HOW TO APPLY

Please complete the [BU Research Degree Application 2015](#) and submit it via email to the Postgraduate Administrator for Admissions (pgradmissions@bournemouth.ac.uk) by **24 November 2015**. Further information on the application process can be found at [www.bournemouth.ac.uk/phd-2015](#)