## PROJECT DETAILS

### Project Title
Research and development of new concepts related to hydraulic control valve design applicable to a wide range of 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, commercial and military 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, using 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 system that can result in a major technological leap in control system technology. Hydreco intends to collaborate with the Design Simulation Research Centre (DSRC) at BU in order investigate and evaluate the potential benefits of a new design of hydraulic valve.

Due to the size of the research required, two parallel projects will be conducted. The first project will study the viability of replacing the current single multi-functional multi-spool valve design with the proposed novel three parallel, smaller single function spool valve system. The second study will investigate the feasibility of developing a control system utilising absolute and differential pressure measurements between the inlets and outlets of the proposed valve system.

The overall aim of the research is to reduce the complexity of the current commercially used hydraulic valve systems in order to decrease maintenance cost and time while increasing the efficiency. The proposal focuses on the first of these two projects.

An initial review of the current state of the art in hydraulic valve design has revealed that it has become increasingly important to develop energy saving hydraulic circuits, without compromising their functionality and performance, to limit pollutant emissions to meet target guidelines and fuel consumption to reduce cost (Borghi et al. 2014; Huova et al. 2010; Williamson et al. 2008). These studies also show that further research is needed in this area. Borghi et al. (2014) states that the combined use of simulation tools and experimental testing represents the most promising way to develop alternative solutions. Bullough et al. (2008) states advances in computational practices allow the pre-prototype design of smart fluid devices to be contemplated. In conclusion, there is a clear requirement for this research driven not only by the company but also by tightened government legislation. In addition, the review has indicated the most suitable methodology to use to investigate the functionality of the valve system.

To achieve the aim of this project, the following key objectives need to be investigated and evaluated:

1. new design and technology concepts.
2. new valve concept optimisation.
3. distributed valve network optimisation.
4. unit costs advantages/benefits.
5. manufacturing cost analysis.
6. design for ease of maintenance.


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 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 system. 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 to develop the new generation modern 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 knowledge. 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 hybrid new systems that save fuel while delivering the same performance are advantageous as they reduce 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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<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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<td>Philip Sewell</td>
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#### Recent publications by supervisors relevant to this project


### INFORMAL ENQUIRIES

To discuss this opportunity further, please contact either Professor Siamak Noroozi via email: snoroozi@bournemouth.ac.uk
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<td>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.</td>
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<td>Please complete the BU Research Degree Application 2014 and submit it via email to the School Research Administrator – Naomi Bailey - <a href="mailto:scitechresearch@bournemouth.ac.uk">scitechresearch@bournemouth.ac.uk</a> by 30 July 2014. Further information on the application process can be found at <a href="http://www.bournemouth.ac.uk/phd2014">www.bournemouth.ac.uk/phd2014</a></td>
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