BU STUDENTSHIPS 2023

PROJECT DESCRIPTION

PROJECT TITLE
Sustainable product life cycle and avoidance of Hazardous materials for electrical motors and gears
PROJECT SUMMARY

This is an exciting research opportunity in collaboration with our industry partner Parvalux Electric Motors Ltd. With over 70 years' experience creating motors, gearboxes and offer thousands of AC, PMDC and BLDC motor options.

Parvalux Electric Motors Ltd was first established in 1947. The business relocated to Bournemouth on England's south coast in 1957, where it started designing and manufacturing complete gear-motor units for industrial applications. In 2008, Parvalux acquired Essex-based EMD Drive Systems Ltd. and relocated it to Bournemouth, nearly doubling the company's turnover in the process. The Clark Group's ownership of Parvalux came to an end in December 2018 when maxon motor, the specialist for mechatronic drive systems, acquired the company.

One third of useful energy is lost within the interacting systems due to friction. The economic costs of these losses are in billions of pounds in GDP. Optimisation of frictional losses within interacting system will make "energy savings of around 55% in transportation, 40% in power generation, 25% in manufacturing industry and 20% in residential sector" [source].

Led by BU's Professor Zulfiqar Khan this project aims to answer the key questions in terms of (i) how to adapt Parvalux design and materials of new motors and gear boxes to allow maintenance or end of life reusability and (ii) which materials currently used in Parvalux motors and gears shall be discontinued or not used in new products development, due to the new RoSH and REACH normative and to which materials they could be replaced to.

Sustainability and people health and safety are crucial topics for all organizations, including Parvalux and therefore gaining knowledge in these areas are an important step for Parvalux future products development processes and guidelines.

ACADEMIC IMPACT

New legislations and associated compliance as mentioned above are key factors which dictate the choice of future materials and their lubrication in interacting systems. Currently there is no comprehensive framework of a mix of lubrication impacts, material degradation both wear and corrosion and remaining life assessment techniques.

Developing such novel framework supported by efficient and reliable experimentally derived algorithms will create new knowledge to fully understand contact mechanics subject to lubrication, leading to accurately predicting failures to inform holistic design solutions will bring significant academic benefits to research communities, scientists, academics and students. New knowledge will help inform academic provisions within mechanical and design engineering.

SOCIETAL IMPACT
Implementing advanced and efficient solution to solve interacting contacts subject to lubrication and varying regimes, depending on their operating conditions, will make direct contributions to energy recovery by reducing frictional forces; "on global scale these savings will amount to 8.7% of total energy consumption" [source]. Implementing advanced interacting contact solutions will result in "reducing CO_2 emissions by 3140 $MtCO_2$ (metric tonnes equivalent of CO_2) and cost savings of 970 billion Euros" [source]. "*The amount of waste electrical and electronic equipment (WEEE) generated every year in the EU is increasing rapidly. It is now one of the fastest growing waste streams. Electrical and electronic equipment (EEE) contains hazardous substances. Since 2003, EU laws have restricted the use of these hazardous substances.*" [Source]. Both environmental and economic benefits will bring significant societal impacts and will enhance living standards especially within the context of energy and environment.

PGR DEVELOPMENT OPPORTUNITIES
A major part of this project will utilise theoretical, experimental and numerical methods. Training will be provided at BU on the use of rolling and sliding testing tribometer, micro friction machine, Buehler Vickers indentation, Olympus BX 60 optical microscopy, 3D surfaces' mapping Zygo New View 5000, Agar sputter gold surface coater, Jeol JSM 5300 Scanning Electron Microscope and Nano Indentation System. These facilities are available at BU. In addition scratch testing and rolling contact fatigue testing are also available and the PGR will be trained to conduct tests on these equipment. Other training or personal & professional development courses e.g. research methods are provided by the University Graduate College.

SUPERVISORY TEAM	
First Supervisor	Professor Zulfiqar Khan
Additional Supervisors	Florbela Costa (head of engineering/industry supervisor), Dr Diogo Montalvao and Dr Mayank Anand.
Recent publications by supervisors relevant to this project	1. Liu, C., Tian, Y., Khan, Z.A. and Meng, Y., 2023. Mitigation of tribocorrosion of metals in aqueous solutions by potential-enhanced adsorption of surfactants. Friction, 11 (5), 801-819. 2. Sun, J., Bai, L., Guo, F. and Khan, Z.A., 2022. Experimental Study on the Effect of Micro-Texture on EHL Point-Contact Film Thickness Subject to Sliding Conditions. Materials, 15 (22). 3. Abdullah, M.U. and Khan, Z.A., 2022. Further Investigations and Parametric Analysis of Microstructural Alterations under Rolling Contact Fatigue. Materials, 15 (22). 4. Abdullah, M.U. and Khan, Z.A., 2022. A Multiscale Overview of Modelling Rolling Cyclic Fatigue in Bearing Elements. Materials, 15 (17). 5. Patel, R., Khan, Z.A., Saeed, A. and Bakolas, V., 2022. CFD Investigation of Reynolds Flow around a Solid Obstacle. Lubricants, 10 (7). 6. Babutskyi, A., Akram, S., Bevilacqua, M., Chrysanthou, A., Montalvao, D., Whiting, M. and Pizurova, N., 2023. Improvement of cavitation erosion resistance of structural metals by alternating magnetic field treatment. Materials and Design, 226 (2023). 7. Reis, L., Da Costa, P.R., Pereira, R., Montalvão, D. and Freitas, M., 2022. Crack path and fracture surface analysis of ultrasonic fatigue testing under multiaxial loadings. Engineering Failure Analysis, 142. 8. Akram, S., Babutskyi, A., Chrysanthou, A., Montalvão, D., Whiting, M.J. and

	Modi, O.P., 2021. Improvement of the wear resistance of EN8 steel by application of alternating magnetic field treatment. Wear, 484-485 9. Bowkett, M., Nazir, M.H., Hussain, M.M., Khan, Z.A. and Akram, R., 2022. Failure Detection within Composite Materials in System Engineering Applications. Applied Sciences (Switzerland), 12 (9). 10. Bai, L., Meng, Y., Zhang, V. and Khan, Z.A., 2021. Effect of Surface Topography on ZDDP Tribofilm Formation During Running-in Stage Subject to Boundary Lubrication. Tribology Letters, 70, 1-16. 11. Waqas, M., Zahid, R., Bhutta, M.U., Khan, Z.A. and Saeed, A., 2021. A review of friction performance of lubricants with nano additives. Materials, 14 (21). 12. Karbasi, M., Keshavarz Alamdari, E., Amirkhani Dehkordi, E., Khan, Z.A. and Tavangarian, F., 2021. Enhanced mechanical properties and microstructure of accumulative roll-bonded co/pb nanocomposite. Nanomaterials, 11 (5). 13. Abdullah, M.U., Khan, Z.A. and Kruhoeffer, W., 2020. Evaluation of Dark Etching Regions for Standard Bearing Steel under Accelerated Rolling Contact Fatigue. Tribology International, 152. 14. Abdullah, M.U., Khan, Z.A., Kruhoeffer, W. and Blass, T., 2020. A 3D Finite Element Model of Rolling Contact Fatigue for Evolved Material Response and Residual Stress Estimation. Tribology Letters, 68 (4). 15. Saeed, A., Khan, Z., Nazir, H., Hadfield, M. and Smith, R., 2017. Research impact of conserving large military vehicles through a sustainable methodology. International Journal of Heritage Architecture, 1 (2), 267-274.

INFORMAL ENQUIRIES

Please contact the lead supervisor on the following email for informal enquiries: Please direct all informal inquires to Professor Zulfiqar Khan by emailing to zkhan@bournemouth.ac.uk or over the Phone: 0044-1202-961645.

ELIGIBILITY CRITERIA

The BU PhD Studentships are open to UK, EU and International students.

Candidates for a PhD Studentship should demonstrate outstanding qualities and be motivated to complete a PhD in 4 years and must demonstrate:

- outstanding academic potential as measured normally by either a 1st class honours degree (or equivalent Grade Point Average (GPA) or a Master's degree with distinction or equivalent
- an IELTS (Academic) score of 6.5 minimum (with a minimum 6.0 in each component, or equivalent) for candidates for whom English is not their first language and this must be evidenced at point of application.

ADDITIONAL ELIGIBILITY CRITERIA

First and master's degrees in mechanical, or environmental or materials or relevant engineering disciplines are essential. Candidate is expected to demonstrate knowledge, understanding and experience of tribology (wear, friction and lubrication) and materials in general. Strong academic profile in engineering maths or applied mathematics is essential. Basic or fundamental knowledge and understanding of RoSH (Restriction of Hazardous Substances Directive) and REACH (Registration, Evaluation, Authorization and restriction of Chemicals) will be conducted is desirable.

HOW TO APPLY

Please complete the online application form by **the deadline on the project webpage.**

Further information on the application process can be found at: www.bournemouth.ac.uk/studentships