**EPSRC DLA PhD Studentships**

|  |  |
| --- | --- |
| **First Supervisor** | Professor Paul D. Ledger |
| **School/Department** | School of Computing & Mathematical Sciences (Mathematics) |
| **Email**  | pdl11@leicester.ac.uk |

|  |  |
| --- | --- |
| **Second Supervisor** | Dr Matias Ruiz |
| **School/Department** | School of Computing & Mathematical Sciences |
| **Email**  | mr447@leicester.ac.uk |

|  |  |
| --- | --- |
| **Additional Supervisor** | Professor Antonio Gil, Swansea UniversityDr Mike Mallett, Siemens Healthineers Magnet Technology |

**Section 2 – *Project Information***

|  |  |
| --- | --- |
| **Project Title** | Improved minimisation of ghosting effects in MRI scanner images using anadvanced computational modelling tool for accurate prediction of magneto-mechanical vibrations |
| **Project Summary**  |
| Siemens Healthineers is a global leading company in the manufacture of MRI magnets. A keychallenge for the company is the generation of ghosting artefacts that arise as part of the imaging process. These artefacts present challenges for medical professionals attempting to draw diagnoses from the images. The ghosting artefacts arise due to the strong uniform magnetic field across the bore of the magnet being disturbed by eddy currents and mechanical vibrations of the conducting components of the scanner. Current processes to remove the effects are based on post-processing the images, but with the move towards more sustainable magnet designs, predicting the field perturbations and understanding how to account for them has become very challenging.The aim of this PhD is to develop a computational tool for predicting field inhomogeneities acrossthe bore of the MRI imaging region and to understand how this can be used as part of the imagingprocess to minimise ghosting. The research also aligns with our wider developing research activities on predictive digital twins.The methodology of the PhD will be as follows1. Gain a good physical understanding of the physical engineering processes in the design andbuild of MRI scanners.2. Understand the suite of current computational tools developed by Ledger and Gil to predictmagneto-mechanical coupling in MRI scanners [1] and extend this software to predictcomplex situations in 3D and apply reduced order models for computational efficiency [2].3. Build on existing software bases that lead to tools that can be used by industry by workingeffectively with software libraries.4. Gain familiarity with current techniques used for removing ghosting effects and how thesecould benefit from the additional insights provided by an accurate prediction of the fieldinhomogeneities across the bore of the MRI imaging region.As well as the outstanding opportunities for collaboration with teams of engineers, computer scientists and mathematicians at the University of Leicester, the PhD student will have the opportunity to collaborate with the teams of computational engineering researchers at the Zienkiewicz Institute for Modelling and AI, Swansea University and with the industrial supervisor at Siemens Heathineers Magnet Technology. We look forward to receiving your application.A blue and rainbow colored object in water  Description automatically generated with medium confidenceThe above image shows a test magnet configuration and a distribution of computed magnet fields. |
| **References** |
| [1] M. Seoane, P.D. Ledger, A.J. Gil, S. Zlotnik, M. Mallett, A combined reduced order-full order methodology for the solution of 3D magneto-mechanical problems with application to magnetic resonance imaging scanners, International Journal for Numerical Methods for Engineering,2020;121:3529–3559. DOI: 10.1002/nme.6369 [2] M. Seoane, P.D. Ledger, A.J. Gil, M. Mallett, An accurate and efficient three-dimensional high-order finite element methodology for the simulation of magneto-mechanical coupling in MRI scanners International Journal for Numerical Methods for Engineering, 2019;119:1185–1215. DOI:10.1002/nme.6088. |