QUB - Mechanical and Aerospace Engineering
PhD Project Description

Title: Multi-domain geometry and analysis representations

Theme: Simulation technologies

Project description:

Modern engineering design and analysis processes are highly multi-disciplinary, but modern design and analysis software tools are typically siloed into individual disciplines (e.g. structures, fluids, thermals). As a consequence, the engineers designing the products spend a lot of time:
-creating geometric representations of the different domains which need to be analysed,
-creating the different analysis models for the domains,
- transferring the analysis attributes between the different models
-applying boundary conditions to the different models, and
-transferring results between the models.

QUB have developed the concept of Simulation Intent as a key enabler for future design and analysis processes. Simulation intent has the potential to streamline a lot of the costly design and analysis activities currently faced by industry. The challenge associated with managing different representations of the analysis domain can be handled through building a cellular model of the design. Cellular models are non-manifold, meaning all of the design space is represented by an individual body, and that the interfaces between the different cells are explicitly represented in the model. While this concept has been demonstrated for small components, or simple assemblies, it has not yet been demonstrated on a model of industrial complexity.

Once the cellular model is available, there is a need to be able to create an appropriate analysis model for each of the cells. For many analyses this will require an idealised analysis model, and so the shape of the simulation model will not match that of the cells in the cellular model, and so the equivalence between the analysis model and the cell needs to be established and retained.

This PhD will aim to demonstrate the creation of a cellular model for a complex component, including constructing prototype tools for the creation of the cellular model from a CAD model assembly. This will then be used as a framework for the creation of equivalent analysis models of the different cells, including prototype tools for transferring results from one model and applying them as boundary conditions on the other.

By following this path, it is envisaged that an advanced design and analysis capability will be demonstrated.

Aims and Objectives:

The objectives of this project are to investigate new

- approaches for creating cellular models from complex CAD model assemblies
- strategies for linking different geometry and analysis representations of complex components.
- approaches to demonstrate the effectiveness of promising strategies by the construction of prototype software tools

Key skills required for the post: An interest in CAD and CAE modelling.

Key transferable skills that will be developed during the PhD: CAD/CAE modelling / scripting

Lead supervisor:	Trevor Robinson
Other supervisor(s):	Name(s) of anticipated other supervisors on project

Funding mechanism:	Yet to be secured
Application closing date:	Specific date or until suitable candidate appointed.
Guaranteed stipend:	This can include a basic stipend and any guaranteed top-up (if available). N.B. Stipend for 20-21 is not yet confirmed. Base stipend for 19/20 is £15,009.
Conditional top-up available:	Amount and condition
PhD students in the School may have the opportunity to apply to be demonstrators on undergraduate modules. Compensation for this can amount to in excess of £2,400 per year.	

Queens University Belfast is a diverse and international institution which is strongly committed to equality and diversity, and to selection on merit. Currently women are under-represented in research positions in the School and accordingly applications from women are particularly welcome.