Department	School of Engineering and the Built Environment
Supervisors	Dr Chennakesava Kadapa and Dr Firdaus Muhammad Sukki
Project Title	Computational modelling of flexible wave energy converters

PROJECT DESCRIPTION

Whilst solar and wind energies have become dominant options in the renewable energy sector, wave energy is yet to become truly competitive. For wave energy to attract renewable energy marks and becomes truly competitive, new designs and concepts of wave energy converters that are cost-effective and energy-efficient are essential. Recent advances in multifunctional polymeric composites over the past couple of decades have led to the exploration of alternative designs for wave energy converters (WECs) that involve flexible structures or a combination of rigid and flexible structures for wave energy harvesting.

The challenges in simulating flexible WECs are multifold: (i) interaction of thin flexible lightweight structures with wave currents, (ii) large structural deformations, (iii) couplied viscoelasticity at finite strains, (iv) multiphase flows and (v) large-scale models. Towards addressing challengings in simulating wave-structure interaction problems with flexible lightweight structures, this project will develop advanced simulation platforms with the capabilities to conduct computationally efficient high-fidelity coupled simulations of flexible WECs. This project includes collaborations with other universities in the UK.

The project consists of the following major activities:

- Couple FE framework for flexible solids with CFD solvers.
- Validate the simulation framework.
- Explore different designs for flexible WECs.
- Disseminate research outputs in journals and at conferences.

Perspective applicants are encouraged to contact the Supervisor before submitting their applications. Applications should make it clear the project you are applying for and the name of the supervisors

Academic qualifications

A first degree (at least a 2.1) ideally in Mechanical/Civil/Aerospace/Ocean Engineering or Mathematics or related fields with a good fundamental knowledge of solid mechanics, fluid mechanics, finite element method, numerical methods and computer programming.

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

Essential attributes:

- Experience of fundamental in solid mechanics, fluid mechanics, and FEM and/or FVM.
- Competent in programming in either MATLAB or Python or Julia or C++ or Fortran.
- Knowledge of numerical methods, modelling and simulation.
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

- Experience in using simulation software such as ANSYS, Abaqus, OpenFOAM, and SU2 etc.
- Programming in C++.
- Knowledge of research software development.

Indicative Bibliography	[1] Collins, I., Hossain, M., Detterm W., and Masters, I. (2021), 'Flexible membrane structures for wave energy harvesting: A review of the developments, materials and computational modelling approaches', Renewable Sustainable Energy Reviews. 151, p. 111478. [2] Kadapa, C., Wang, X. and Mei, Y. (2022) 'A comprehensive assessment of accuracy of adaptive integration of cut cells for laminar fluid-structure interaction problems', Computers & Mathematics with Applications, 122, pp. 1-18. [3] Kadapa, C. and Hossain, M. (2020) 'A robust and computationally efficient finite element framework for coupled electromechanics', Computer Methods in Applied Mechanics and Engineering, 372, p. 113443. [4] Kai, L. Y., Sarip, S., Kaidi, H. M., Ardila-Rey, J. A., Samsuddin, N. M., Muhtazaruddin, M. N., Muhammad-Sukki, F., and Aziz, S. A. (2021), 'Current status and possible future applications of marine current energy devices in Malaysis: A review', IEEE Access, 9, pp. 86869-86888.
Enquiries	For informal enquiries about this PhD project, please contact Dr Chennakesava Kadapa at c.kadapa@napier.ac.uk.
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process