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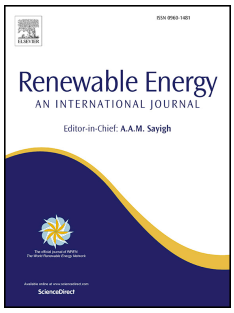

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PII: S0960-1481(17)30920-5

DOI: 10.1016/j.renene.2017.09.058

Reference: RENE 9256

To appear in: *Renewable Energy*

Received Date: 16 February 2017

Revised Date: 30 August 2017

Accepted Date: 16 September 2017

Please cite this article as: Avdis A, Candy AS, Hill J, Kramer SC, Piggott MD, Efficient unstructured mesh generation for marine renewable energy applications, *Renewable Energy* (2017), doi: 10.1016/j.renene.2017.09.058.

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Efficient unstructured mesh generation for marine renewable energy applications

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Abstract

Renewable energy is the cornerstone of preventing dangerous climate change whilst maintaining a robust energy supply. Tidal energy will arguably play a critical role in the renewable energy portfolio as it is both predictable and reliable, and can be put in place across the globe. However, installation may impact the local and regional ecology via changes in tidal dynamics, sediment transport pathways or bathymetric changes. In order to mitigate these effects, tidal energy devices need to be modelled in order to predict hydrodynamic changes. Robust mesh generation is a fundamental component required for developing simulations with high accuracy. However, mesh generation for coastal domains can be an elaborate procedure. Here, we describe an approach combining mesh generators with Geographical Information Systems. We demonstrate robustness and efficiency by constructing a mesh with which to examine the potential environmental impact of a tidal turbine farm installation in the Orkney Islands. The mesh is then used with two well-validated ocean models, to compare their flow predictions with and without a turbine array. The results demonstrate that it is possible to create an easy-to-use tool to generate high-quality meshes for combined coastal engineering, here tidal turbines, and coastal ocean simulations.

Keywords: Mesh generation, Geographical Information Systems, Research Data Management, Tidal turbine arrays, Renewable energy generation, Pentland Firth

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