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# Slender flexible structures in OpenFOAM

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## ABSTRACT

Volume of fluid based methods have become a widely applied tool for the simulation of marine structures. Resolving slender structural members is often a considerable challenge, due to the need to resolve domain dimensions of the order of 100 meters in the same mesh.

In some applications, actuator line methods have been applied with great success, for example for tidal turbines. Actuator line methods apply a force corresponding to the opposite of the drag and lift experienced by the structures cross section to the fluid. Force values are typically based on empirical formulae or evaluated separately and the structure is not represented in the domain mesh but defined by element coordinates.

Slender structures under fluid loading often experience deformations. Coupling an actuator line model with a Finite Element Beam element model allows to efficiently assess the deformation and wake of slender structures under fluid loading. This paper presents an implementation and first results of the coupling between turbinesFoam [1], an actuator line model for OpenFOAM, and an FEA beam element model implemented in C++ based on [2].

- [1] Bachant, P., Goude, A., and Wosnik, M. (2016) *Actuator line modeling of vertical-axis turbines*. arXiv preprint 1605.01449.
- [2] Felton, Lewis P.; Nelson, Richard B., *Matrix Structural Analysis*, 1966, Wiley