

FSI of Inflatable Kite Wings

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A novel fluid-structure interaction (FSI) simulation framework is being developed at the KitePower group of TU Delft. Developing an FSI simulator suitable for the kite problem has to take into account the following factors.



Figure 1: Inflated canopies modeled using Madymo. [1]

- Finite Element (FE) computing techniques- Structural and Aerodynamic
- Non-linearities in the FSI model
- Modelling inflatable structures

FSI Framework

In the initial phase, a minimal structural solver with the capacity to resolve nonlinear structural dynamics on 2D membrane elements will be coupled with an existing CFD code.

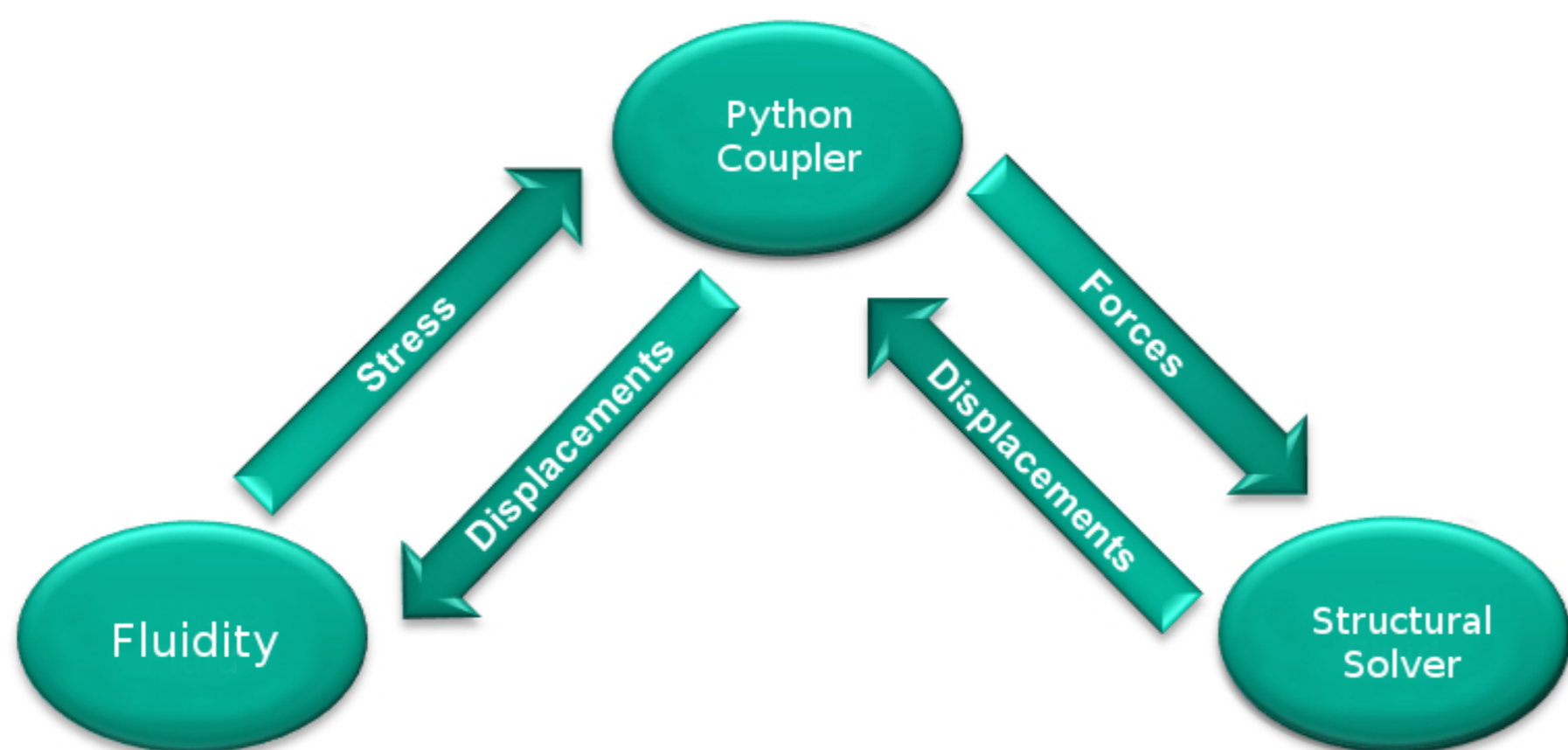


Figure 2: Fluidity [2]- Open Source CFD on Finite Elements, coupled with in-house structural solver.

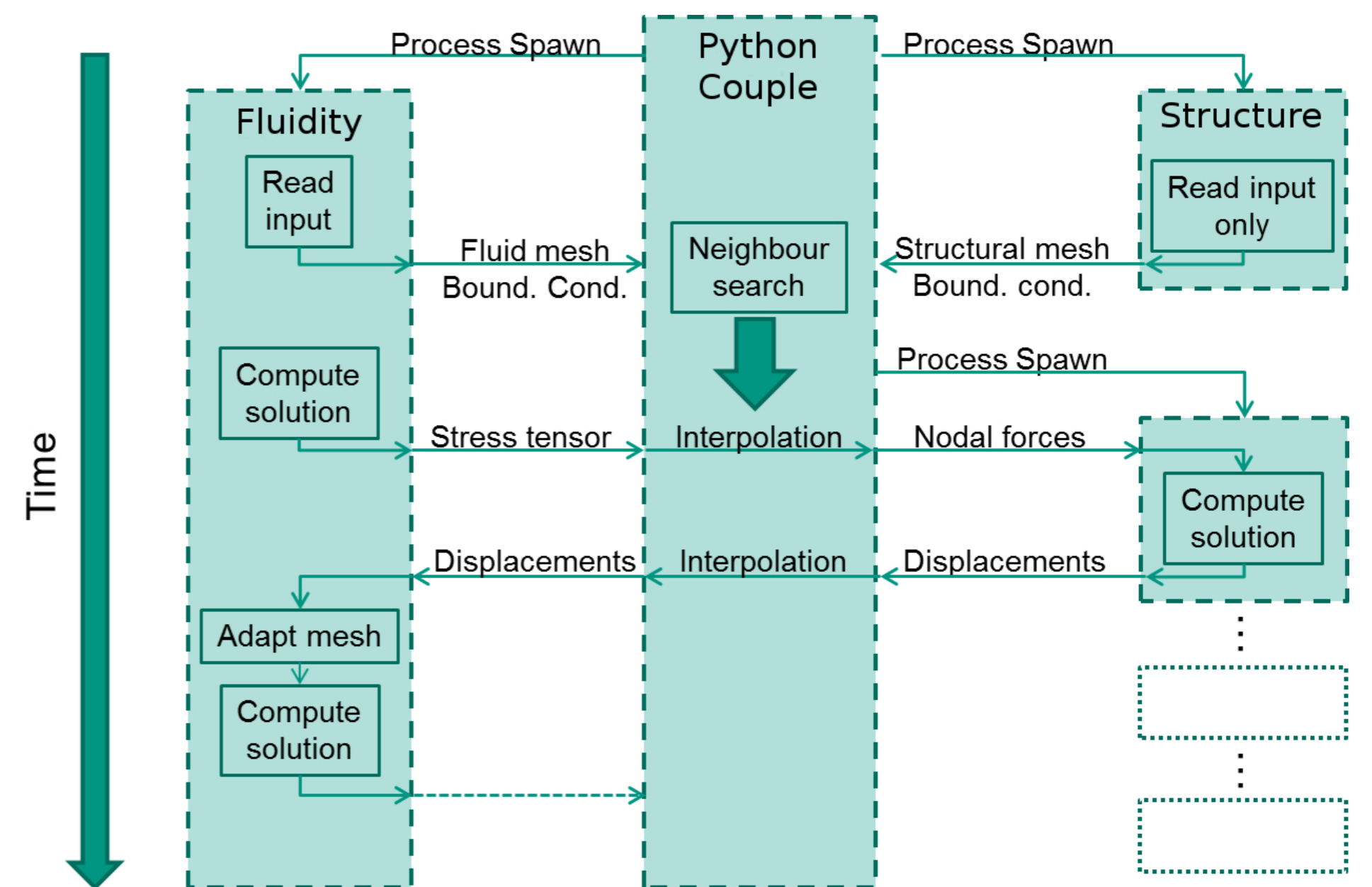


Figure 3: Conventional staggered iterations at the initial phase of development.

Over the course of the project the structural solver will be enhanced with advanced modeling capabilities and nonlinear FSI iterations will be implemented.

Application

The outputs of the FSI simulator will provide better insight into kite dynamics. The framework can be utilized in the optimization of flight paths and in the enhancement of kite performance.

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References

- [1] Schwoll, J. "Finite element approach for statically loaded inflatable kite structures". Master's thesis, TU Delft.
- [2] *Fluidity Manual*. Applied Modelling and Computation Group, Imperial College London.