Pumping fluid with an undulating membrane

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Figure 1: Schematic of the wave pump concept. You should also watch the video from the start-up CorWave!
http://www.corwave.fr/products/

**Subject**

A big part of everyday life processes requires pumping systems to move a fluid from one place to another - whether it is to filter the water of your aquarium or to keep the blood running through your circulatory system. Several concepts of pump have been developed. All have their advantages, but they also have restrictions inherent to their nature: for example the high blade velocity of rotary pumps is prone to damage fluid with delicate components such as blood.

Recently, an alternative pump concept has been introduced, that is called a progressive wave pump [1]. Its operation is shown in Fig 1, it involves a deformable elastic membrane placed between two housing walls that channel the fluid. The idea is to create a progressive wave from the outer edge of the membrane through external forcing. This wave travels along the elastic membrane toward the center, propelling the fluid inward.

The pump is a multiphysics system, where the fluid flow and the deformable membrane both evolve in a coupled way. Such fluid/structure interaction is ubiquitous in nature, and you have probably already seen it when watching a flag flap in the wing or an eel propelling underwater through body undulations. Using an approach similar to that of flapping flags or propulsion [2, 3], we will develop in this internship a semi-analytical model to understand the interaction of the elastic membrane with its surrounding fluid. This internship will draw from both vibration of elastic structures and fluid mechanics problems. In particular, we will investigate how the parameters governing the vibrational response of the membrane (e.g. its elasticity or the forcing applied) affect the efficiency of the pump (its flow rate). We will also look at the effect of confinement -that is the presence of housing wall on both sides of the membrane- on the operation of the pump. Comparison with experimental data on a physical prototype of the pump can be envisaged to test the obtained theoretical predictions. The internship will be in collaboration with Saint-Gobain Recherche (contact SGR: Sara Quiligotti).

**References**

