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Resonance wave pumping: wave mass transport pumping[1]
REMI CARMIGNIANI, ENPC, DAMIEN VIOLEAU, EDF-ENPC, MORTEZA GHARIB, Caltech — It has been previously reported that pinching at intrinsic resonance frequencies a valveless pump (or Liebau pump) results in a strong pulsating flow. A free-surface version of the Liebau pump is presented. The experiment consists of a closed tank with a submerged plate separating the water into a free-surface and a recirculation section connected through two openings at each end of the tank. A paddle is placed at an off-centre position at the free-surface and controlled in a heaving motion with different frequencies and amplitudes. Near certain frequencies identified as resonance frequencies through a linear potential theory analysis, the system behaves like a pump. Particle Image Velocimetry (PIV) is performed in the near free surface region and compared with simulations using Volume of Fluid (VOF) method. The mean eulerian mass flux field (ρu) is extracted. It is observed that the flow is located in the vicinity of the surface layer suggesting Stokes Drift (or Wave Mass Transport) is the source of the pumping. A model is developped to extend the linear potential theory to the second order to take into account these observations.

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