Global and Local Response of Submerged Floating Tunnels to Hydrodynamic Loads

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Seabed-anchored Submerged Floating Tunnels (SFTs) are structures made of watertight tubular segments, assembled together and kept floating under the water table by a spread system of anchoring elements (mooring system) connected to the seabed.

A distinctive feature of the dynamic behavior of SFTs is the presence of both global vibration modes, that involve significant displacements of the tunnel and quasi-static displacements of the anchoring elements, and local modes, that mainly involve transverse vibrations of the anchors. Dominant global and local modes of the structure are typically associated to well-separated values of the natural frequencies. However, computationally efficient Finite Element (FE) models able to simultaneously capture the main features of both global and local vibration modes with the same degree of accuracy, are inherently hard to set up.

To overcome this difficulty, a dynamic substructuring technique is here adopted. A separate modeling of the two main substructures is employed, involving (1) a Reduced Order Model (ROM) of the anchoring elements, which accounts for both geometrical nonlinearities and a generic form of supports motion, and (2) a continuous model which describes the submerged tube as an Euler-Bernoulli beam. Both the global and the local response of SFTs to hydrodynamic loadings is then studied, by accounting for the interactions between the two subsystems, within this novel framework.