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Vibration of a submarine hull under harmonic propeller-shaft excitation

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A model to describe the dynamic response of submarine hull to a harmonic propeller shaft excitation is presented. The submarine is modelled as a ring stiffened cylindrical shell, with bulkheads and end caps. The stiffeners are introduced using a smeared approach. The bulkheads are modelled as circular plates with in plane and bending motion, and the end closures are modelled as truncated conical shells. External fluid loading is introduced to take into account the interaction of the structure with the acoustic medium. The propeller introduces a harmonic varying force in both the axial and transverse directions. The force is transmitted to the structure through the shaft that is connected to the end plate of the cylindrical hull and supported by the conical end cap. The axial component excites the axisymmetric modes of the structure. The transverse force component excites the hull through the conical shell and excites the higher circumferential modes. Since these modes are mainly flexure in nature, they can result in a high noise signature level. Results are presented in terms of FRFs calculated analytically and compare the axisymmetric vibration caused by the axial excitation and the asymmetric response due to the transverse component of the force.