

COLLABORATIVE RESEARCH CENTER 837

## INTERACTION MODELING IN MECHANIZED TUNNELING

RUB

# UNUSUAL VIBRATION PHENOMENA IN THIN WALLED STRUCTURES

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In the recent years the characterization of thin-walled structure dynamics has received great interest from the scientific community due to the complexity of such structures and the wide range of applications in Engineering from macro to nanoscales: aircrafts, missiles, propellant tanks, heat exchangers, micro-electro-mechanical systems, nanotubes, etc.

A series of experiments were recently carried out in the Vibration and Powertrain Lab with the goal of investigating the influence of the environment on the dynamics of shells and the onset of novel and unknown kind of behaviors. In particular, the following aspects of the shell dynamics

are investigated: thermal conditions, type of forcing, fluid structure interaction.

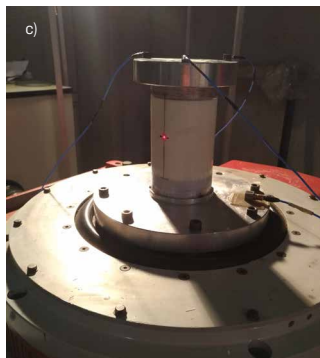
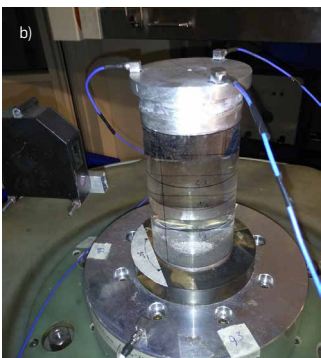
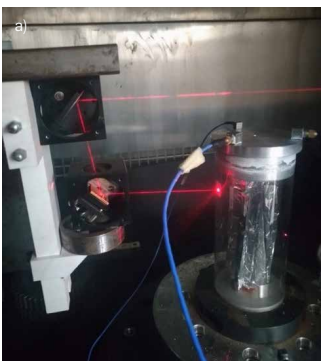


Figure 1: Polymeric circular cylindrical shell with a top mass: a) empty shell; b) water filled; c) filled with non-Newtonian fluid

Figure 1 shows three experimental setup of an empty or fluid-filled circular cylindrical shell; the excitation is from the base. The material is polymeric and the shell carries an aluminum mass on the top, the system is excited through an electrodynamic shaker.

Experiments show the extreme complexity of the dynamic scenario. Transitions from deterministic to chaos and vice-versa are evidenced: when the excitation is harmonic (deterministic) the response can be periodic, quasiperiodic or chaotic; when the excitation is random the synchronization, and extremely uncommon, phenomenon can lead to a periodic response even though a random response is generally expected.

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