Attractors for nonlinear hyperbolic systems with boundary dissipation on an interface- arising in nonlinear structural acoustic.

Irena Lasiecka [1],[2]

[1]) University of Memphis
[2]) University of Virginia
lasiecka@memphis.edu

Long time behavior of a 3 dimensional nonlinear hyperbolic systems with a coupling on a 2 dimensional manifold-interface will be discussed. Specific applications include 3-D structural acoustic interaction with a nonlinear noise entering an acoustic chamber and an elastic wall modeled by a super-linear Kirchhoff-Boussinesq dynamic plate/shell equation . This model arises within a context of noise suppression/control in an acoustic chamber surrounded by a combination of rigid and elastic walls. This topic, owning to an array of technological applications, has been under studies for many years in both engineering and mathematical literature. The introduced model became an inspiration to fuel new mathematical developments in the area of analysis, PDE's and control theory. A brief review of the "old" and "new" results will be presented. In the model under consideration particular emphasis is given to nonlinear interactions- [supercritical] oscillations and boundary-interface control used for the suppression/steering dynamics to a well defined target. The attenuation/control of the noise takes place on the elastic wall which, by itself, is modeled by plate equation with supercritical restoring forces and Boussinesq nonlinear term leading to a potential finite time blow up of solutions. In addition to Boussinesq source [resulting from a strong nonlinear coupling between vertical and transverse shear effects in the Midlin Timoshenko system], plate dynamics is ignited by an acoustic pressure exerted by waves propagation in an acoustic chamber. The key to the result is the presence of boundary feedback control applied on the elastic wall. Hadamard wellposedness of weak and strong solutions will be discussed along with the long time behavior of the corresponding solutions. Theory of attractors will be presented. From the mathematical point of view, the interesting features include: the lack of dissipativity, the loss of compactness due to nonlinear plate effects and tthe lack of time reversibility resulting from the boundary actions within the acoustic medium. As it is well known, these features are the fundamental building blocks in the qualitative theory of of long time dynamics arising in hyperbolic like systems. To contend with the problem, a new "hybrid" method, suitable for handling long time behavior of coupled dynamics with a mismatch and "poor communication" on the interface will be presented. The theory is based on recent compensated compactness criteria and quasistability methods developed for non-dissipative and non-conservative hyperbolic dynamical systems.