Linear and Nonlinear Dispersive Wave Equations in Domains with a Boundary

Dionyssis Mantzavinos
Department of Mathematics, University of Kansas
mantzavinos@ku.edu

ABSTRACT

A plethora of physical phenomena are modeled by partial differential equations (PDEs). In the case of waves in water, optical fibers, Bose-Einstein condensates, or other media, one encounters the phenomenon of dispersion, namely waves of different frequencies (or, equivalently, wavelengths) propagating at different speeds. The associated PDEs are referred to as dispersive, and their analysis has been at the center of interest within the broader PDE/harmonic analysis/nonlinear waves communities during the past several decades. In this talk, we will emphasize the importance of studying dispersive PDEs in the presence of nonzero boundary conditions. Such conditions are directly motivated by applications that take place in domains with a boundary, either in nature or in the laboratory. The relevant problems are known as initial-boundary value problems and their study turns out to be significantly more involved than the one of the more standard initial value problems, which take place on the entire space. Our focus will be placed on a method developed in recent years specifically for the proof of Hadamard well-posedness (existence, uniqueness, and continuous dependence of solution on the data) of nonlinear dispersive PDEs in the context of initial-boundary value problems. Prototypical dispersive PDEs like the nonlinear Schrödinger and the Korteweg-de Vries equations will serve as motivating examples in order to guide us through the main steps of the analysis.