HEAT CONDUCTING FLUIDS IN DOMAINS WITH OPEN BOUNDARIES

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Abstract. Many problems of interest in fluid mechanics are (in practice) conceived in unbounded spatial regions, but then solved numerically in bounded domains. In particular, this requires the restriction of the physical domain and the prescription of boundary conditions on the new boundaries.

The problem that motivates this talk falls into the above category: Describing the temperature, velocity, and pressure of the air in a heated room that possesses a door which is always open. Given that the problem may become numerically intractable if we try to consider it in an unbounded domain that contains the room in question, we restrict the physical domain to the aforementioned room. In particular, this implies that we need to address relations of the variables of interest via an appropriate selection of boundary conditions. While this is quite simple to do on the walls of the room (whether they are insulated or heated), it is a major problem on the open door.

In this talk, we present a mathematical model given by the stationary Boussinesq equations supplemented with mixed boundary conditions. At the open boundary, we consider a classical do-nothing condition for the fluid flow and a novel velocity-temperature nonlinearly coupled condition for the heat transfer. The remaining part of the boundary is supplemented with Dirichlet and/or Neumann type conditions. In addition, we present a weak formulation for this model and a proof sketch of the existence of weak solutions.

The content of this talk is a joint work with Rafael Arndt and Carlos N. Rautenberg from the Humboldt-Universität zu Berlin and the Weierstrass Institute for Applied Analysis and Stochastics (WIAS), Germany.

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