Oberseminar Nichtlineare Differentialgleichungen

Jun.-Prof. Christina Lienstromberg - Prof. Guido Schneider - Prof. Wolf-Patrick Düll

Dr. Richard Schubert
Universität Bonn

A variational approach to data-driven problems in fluid mechanics

20. Mai 2022 - 10:45 - WebEx Meeting

Den Webex-Zugang erhalten Sie bei Katja Stefanie Engstler

Abstract: In this talk, we discuss a data-driven approach to viscous fluid mechanics. Typically, in order to describe the behaviour of fluids one uses two different kinds of modelling assumptions. On the one hand, there are first principles like the balance of forces or the incompressibility condition. On the other hand there are material specific constitutive laws that describe the relation between the strain and the viscous stress of the fluid. Combining both, one obtains the partial differential equations of fluid mechanics like the Stokes or Navier-Stokes equations. The constitutive laws are typically obtained by fitting a law from a certain class (for example linear, power law, etc.), that is assumed to be the correct one for the fluid, to experimental data.

In the data-driven approach, we propose to skip the second step of modelling. Instead of using a constitutive law we directly use data points. This leads to a variational solution concept, that incorporates differential constraints coming from first principles and produces fields that are as close to the data as possible. We will see that this variational formulation is a suitable tool to analyse the convergence of the experimental data by increasing experimental accuracy and we will prove that the associated solutions are consistent with PDE solutions if the data are given by a constitutive law. We will furthermore discuss advantages of this new solution concept.

This talk is based on joint work with Christina Lienstromberg (Stuttgart) and Stefan Schiffer (Bonn).

Gemeinsame Veranstaltungsreihe des Lehrstuhls Analysis und Modellierung
und der Abteilung für Differentialgleichungen

Institut für Analysis, Dynamik und Modellierung IADM
Pfaffenwaldring 57, 70569 Stuttgart