Kinetic and Hyperbolic Equations with Applications to Engineering Processes

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Abstract

In this seminar we will give a brief introduction to the modeling hierarchy of particle based dynamics, kinetic equations, and hydrodynamic descriptions in the case of gas dynamics. This summary will aid as a guideline to a derivation of a analog modeling hierarchy in the following.

The first application will consider a steel rolling process. We will introduce a particle based dynamic describing the evolution of the (considered) properties of each workpiece in a steel mill. From this we will establish a kinetic equation to this process and finally take a fluid-like limit to gain a hydrodynamic equation of the steel rolling process. Such a fluid-like description – in theory – might be used to plan and control a production supply chain.

For the second application we will turn back the gas dynamics. Here, we will consider (one-dimensional) isothermal Euler equations (those are 2×2 -conservation laws) and couple such equations in a network. We will introduce a higher-order finite volume scheme that is capable of gathering the evolution of such conservation laws with implicitly coupled boundary conditions via a (possibly) non-linear coupling condition.