

Chapter 7

Solving Ordinary Differential Equations on GPUs

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7.1 Introduction

One of the most common problems encountered in Physics, Chemistry, Biology, but also Engineering or Social Sciences, is to find the solution of an initial value problem (IVP) of an ordinary differential equation (ODE). In fact, many physical laws are written in terms of ODEs, for example the whole classical mechanics, but ODEs also emerge from discretization of partial differential equations (PDEs) or in models of granular systems or when studying networks of interacting neurons. In the most cases one faces ODEs that are too complicated to be solved with analytic methods and one has to rely on numerical techniques to find at least an approximate solution. Of course, there exists a wide range of numerical algorithms to find such solutions of IVPs of ODEs. An introduction to both the mathematical background and the numerical implementation can be found in the textbooks from Hairer, Nørsett and Wanner [14, 15]. The standard work for numerical programming, the “Numerical Recipes” [29] also contains detailed sections on solving ODEs.

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