

Preface

In this book the research of the last decade by the authors regarding deterministic solvers for the Boltzmann transport equation is summarized. The work was started by the third author, who was interested in electronic noise of semiconductor devices. At first glance the use of a deterministic solver seems to be strange, because all groups working at that time on noise in devices solved the Boltzmann transport equation with the stochastic Monte Carlo method, which inherently contains noise and was regarded as the best method to do so. But it soon became clear that the Monte Carlo method, which is also inherently transient, was too slow to calculate noise in the technically relevant frequency range with sufficient accuracy. A deterministic solver on the other hand could yield truly stationary solutions, and exact small-signal analysis could be performed directly in the frequency domain covering the full frequency range. Unfortunately, the deterministic solvers have not only advantages compared to the Monte Carlo method but also disadvantages. The biggest obstacle in the application of deterministic solvers was the huge memory requirement (about 100 GBytes for a realistic 2D device simulation including noise), which is by orders of magnitude larger than the one of the Monte Carlo method. This is the reason, why the interest in deterministic solvers had almost vanished by the end of the last millennium. When this project was started, deterministic solvers still required expensive supercomputers. Fortunately, Moore's law held during the last decade and nowadays computers with sufficient memory are available at a reasonable price. Thus, progress in semiconductor technology solved the biggest problem in applying deterministic solvers to the Boltzmann transport equation.

This work was started in earnest when the third author joined the Institute of Electron Devices and Circuits at the Technical University of Braunschweig in Braunschweig, Germany. A little later the second author joined this institute, which is headed by Prof. Dr. Bernd Meinerzhagen. Both authors are very grateful for his support of their work and his valuable advice. In 2006, the third author became a professor at the Bundeswehr University in Neubiberg, Germany and soon after the first author joined this new group. His position was first funded by the Deutsche Forschungsgemeinschaft (DFG) and later by the Bundeswehr University,

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