

## Modeling and Simulation of Two-Dimensional Single-Electron Control

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### Abstract

Understanding and utilizing the wave nature of individual electrons provides a plethora of opportunities for electron-based quantum technologies, such as quantum information processing and electron quantum optics. At the core of these domains is the need for single-electron control: The ability to coherently guide and manipulate electron states in a pre-determined manner. A particularly attractive way for single-electron control is to use specifically shaped electric potentials which can manipulate a single electron state in various manners, depending on the geometry, size, location, and interaction with other potentials. These potentials can be realized by potential barriers and wells, realized via, e.g., gate electrodes. Overall, the thus necessary modeling and simulation backend requires a full dynamic quantum transport picture, allowing describing intricate effects such as non-locality, interference, and transition to classic transport. This talk will summarize the related modeling and simulation research based on the Wigner function approach and will provide an outlook.

### Keywords

*Electron Quantum Transport; Wigner Function Approach; Quantum Electron Optics; Time-dependent Simulations*

### References

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### Biography

Dr. Josef Weinbub is an Assistant Professor (tenure-track) of High Performance Simulation in Micro- and Nanoelectronics, an IEEE Senior Member, and a Member of the IEEE Nanotechnology Council's Modeling and Simulation Technical Committee. He obtained the doctoral degree in Computational Microelectronics and the *venia docendi* (habilitation) in the

field of Micro- and Nanoelectronics from the TU Wien. He was a visiting researcher at the EPCC, University of Edinburgh and at the Device Modelling Group, University of Glasgow, Scotland, UK as well as at SILVACO Inc., Santa Clara, CA, USA. He founded and now chairs the master's program Computational Science and Engineering at the TU Wien and is involved with several international scientific conferences in various management and scientific roles. He is an Associate Editor of the Journal of Computational Electronics and a Principal Investigator of various research projects funded by, e.g., the Austrian Science Fund and the Christian Doppler Research Association. Together with his team he investigates cutting-edge research problems in the area of computational micro- and Nanoelectronics.