our goal to yield better performance of the hybrid algorithm: almost twice less computational time and approximately five times smaller populations needed, compared to both ACO and GAs, as taken separately.

Directional Regularization Property of the Semigroup Associated to SDEs with Delay *via* Viscosity Solution Theory

M. Rosestolato

We consider a real-valued stochastic dynamics $y(x_0, x_1)$ solving an SDE with infinite delay appearing in the coefficients, given the value x_0 at time 0, and its past x_1 from $-\infty$ up to time 0. The aim is to study the regularity with respect to x_0 of the map $(x_0, x_1) \mapsto \mathbb{E}[g(y(x_0, x_1))]$, with g Lipschitz. To do this, we rephrase the problem in a suitable Hilbert space H, obtaining a Markovian model. Then we prove that the semigroup of the Markovian dynamics is a viscosity solution of a Kolmogorov PDE in H, and relate such a solution with the viscosity solutions of a family of PDEs in $\mathbb{R}$. The regularity is then derived in this last setting.

Stochastic Collocation Methods for PDEs and Some Applications

K. Sabelfeld

We give a detailed description of a new method which we call Stochastic collocation method, for solving boundary value problems with complicated geometry of the domain, singular and random boundary conditions. The method includes two important issues: the first one is the randomization of the original integral equation which results in a large linear system of algebraic equations with random coefficients, the second one is a stochastic SVD based low rank approximation of this system. We show some applications of this method, in particular, the capacitance extraction for polymer chains, evaluation of the capture properties of complicated fractal aerosol particles, and an analysis of the elastic charactersistics of DNS.

Stochastic Alternative to Newton's Acceleration

P. Schwaha, M. Nedjalkov, S. Selberherr, I. Dimov, R. Georgieva

The theoretical equivalence of the Wigner and ballistic Boltzmann equations for up to quadratic electric potentials provides the convenient opportunity to evaluate stochastic algorithms for the solution of the former equation with the analytic solutions of the latter equation - Liouville trajectories corresponding to acceleration due to a constant electric field. The direct application of this idea is impeded by the fact that the analytic transformation of the first equation into the second involves generalized functions. In particular, the Wigner potential acts as a derivative of the delta which gives rise to a Newtonian accelerating force. The second problem is related to the discrete nature of the Wigner momentum space. These peculiarities incorporate unphysical effects in the approximate Wigner solution, which tends to the Boltzmann counterpart in a limiting case only, and resemble the application of the methods of Monte Carlo cellular automata. Numerically the situation is very challenging due to an exponential growth in the number of particles as evolving particles generate pairs of new particles of opposing signs. Parallelization is an important measure in order to reduce the run time of the calculation. Since the number of particles increases during the evaluation of the algorithm, adaptive parallelization methods need to be explored to increase the throughput of the calculations and hence reduce the total run time.

The Role of Annihilation in a Wigner Monte Carlo Approach

J. M. Sellier, M. Nedjalkov, I. Dimov, S. Selberherr

The Wigner equation provides an interesting mathematical limit, which recovers the constant field, ballistic Boltzmann equation. The peculiarities of a recently proposed Monte Carlo approach for solving the transient Wigner problem, based on generation and annihilation of particles are summarized. The annihilation process can be implemented at consecutive time steps to improve the Monte Carlo resolution. We analyze theoretically and numerically this process in the case of the benchmark example provided by the above limit. Then we show that the approach can be used for simulation of realistic quantum phenomena, such as tunneling of a wave packets through potential barriers.

GPU Calculations of Unsteady, Viscous, Compressible and Heat Conductive Gas Flow at Supersonic Speed

K. Shterev, E. Atanassov, S. Stefanov

The recent trend of using Graphics Processing Units (GPUs) for high performance computations is driven by the high ratio of price performance for these units, complemented by their cost effectiveness. Such kinds of units are increasingly being deployed not only as accelerators for supercomputer installations, but also in GPU-enabled