dr. Victor Sofonea

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PhD Project Proposal

Application of discrete Boltzmann models to microfluidics

Microscale fluid flow is an active research topic with numerous applications in vacuum technology, design and fabrication of micro- and nano- electromechanical systems (MEMS), transport through porous media (gas and oil extraction) or blood flow in capillary vessels. In such cases, as well as in rarefied gases and high altitude aerodynamics, the fluid is far from equilibrium and the Knudsen number Kn (defined as the ratio between the mean free path of fluid particles and the characteristic size of the flow domain) becomes non-negligible and the well-known Navier-Stokes equations of fluid mechanics are no longer valid. In such cases, more elaborated models and computer simulation techniques need to be developed to ensure the accurate investigation of physical phenomena and technological processes.

The objective of this PhD Project is the investigation of specific flow problems where the non-negligible value of Kn plays an important role. Recently developed models based on the Boltzmann equation and Gauss-Hermite quadratures will be used for computer simulation of the flow problems. Various types of boundary conditions will be considered (bounce back, diffuse reflection, Maxwell and Cercignani-Lampis). A particular attention will be given to the numerical schemes used to solve the evolution equations in the phase space.

Knowledge of statistical mechanics and thermodynamics is a prerequisite for the PhD candidate. Basic knowledge of Unix systems and computer programming (C or Fortran) is wishful, but not mandatory for applying. During the PhD project, the candidate will become acquainted with numerical schemes for hyperbolic equations, as well as with code programming on high performance parallel computing techniques including Graphics Processing Units (GPUs). After successful completion of the thesis, these skills are expected to help the candidate integrate in scientific or engineering activities in both the academia and the industry.

For further details, please contact dr. Victor Sofonea at **sofonea@gmail.com** or **victor.sofonea@e-uvt.ro**.