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ON THE DETERMINISTIC SOLUTION OF KINETIC THEORY MODELS OF COMPLEX FLUIDS WITHIN THE FOKKER-PLANCK FORMALISM

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ABSTRACT

In the last years, we have assisted to an impressive progression in the numerical modeling capabilities because of the progression in computer science but also in the numerical analysis. Thus, new scales have been explored, allowing modeling of richer and finer physical models. In this work the attention will be focused on models which are defined in multi-dimensional spaces, which have been until now assumed intractable, with the only exception, in our knowledge, of the sparse grid methods.

These models are encountered in various physical domains such as kinetic theory (Fokker-Planck or Vlasof-Poisson-Boltzmann equations) statistical mechanics, quantum mechanics, all these usually encountered in the description of materials at the nanometric or subnanometric scales, in nanoscience and nanotechnology, but also in other domains as for example in financial mathematics.

In highly multidimensional models, standard discretization fails –phenomenon also known as curse of dimensionality- to describe the solution because of the high number of degrees of freedom involved in the simulation (that could reach astronomical values, e.g. 10^{300} or more –remember that 10^{80} corresponds to the presumed number of elementary particles in the universe).

The purpose of this work is to describe some incipient strategies able to address this kind of models that until now has made possible the solution of models defined in spaces of more than hundred dimensions in some specific applications. Obviously this technique does not involve a mesh of the hyper-domain, being the approximation defined using a separated representation [1].

REFERENCES

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