A new concept of construction of adaptive calculation models for Hyperbolic Problems
(a cycle of lectures)

A.M.Blokhin
Novosibirsk Institute of Mathematics
Universitetskii pr.4
Novosibirsk 630090, Russia

Rapid development of methods of mathematical modelling (especially in Continuum Mechanics) became a subject of various discussions in the recent years and it was caused by the wide inculcation of computers into scientific practice. By mathematical modelling in these lectures we mean the chain of necessary steps (we do not go into details naturally):

Generation of the physic model of an event

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Formulation and investigation of the mathematical model

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Construction of the calculation algorithm to find an approximate solution to the mathematical model

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Calculation of the approximate solution with the help of computer and comparing of the obtained results with experimental data

We think that two cells in the middle of the chain are of particular importance. Moreover we will suppose further that mathematical and calculation models have to be considered simultaneously and the properties of mathematical model have to be taken into consideration while constructing the calculation model. We will call such calculation models **adequate calculation models**. We also intend to use only adequate calculation models for finding solutions of mathematical models which are described with the help of Hyperbolic Systems.

The cycle consists of three lectures. In the first lecture we discuss the situation when we violate the principle of adequacy. With this purpose we consider the question on stability of difference schemes on the example of linearized system of GAs Dynamics. Using two well-known difference schemes we show that they are stable if we consider only difference Cauchy problem. If we add boundary conditions (for example, if we consider mixed problem on stability of shock waves in Gas Dynamics) we can show that for any realization of boundary conditions these difference schemes are unstable. So when we construct the calculation model we must take into consideration boundary conditions without fail.

In the second lecture of this cycle we discuss the question of construction of adequate calculation models for quasilinear Gas Dynamic Equations. Using the fact of existence of two forms of record of Gas Dynamic Equations we construct some difference schemes for which we can prove stability in definite sense.

At last in the third lecture of our cycle we consider the concrete example. With this purpose we take so called hydrodynamical models for charge transport in semiconductors. We discuss construction of adequate calculation models on the example of the well-known ballistic diode problem.

Preparatory references.

1. R.D.Richtmyer and K.W.Morton. Difference methods for initial–value problems. Interscience publishers, 1967.

2. A.Harten. On the Symmetric Form of Systems of Conservation Laws with Entropy. -Journal of Comp. Phys., v.49, No.1, 1983, pp.151–164.

3. A.M.Anile, O.Muscato. Improved hydrodynamical model for carrier transport in semiconductors.- Physical Rev.B, 1995, v.51, No.23, pp.16728–16740.