【Science and engineering（Mathematical and physical science）】

Development of computer assisted analysis for complicated nonlinear phenomena

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【Outline of survey】

Computer assisted proof or numerical verification method are mathematically rigorous techniques for the existence of solutions for mathematical problems by numerical computations on computer. These techniques are now, in corporation with exciting development of recent computers, growing up to be important methodology for analyzing complicated nonlinear problems in mathematical analysis and computational science and technology, for which existing theoretical approaches seem to be difficult to apply. The principal researcher has been working on such a verification method for years, particularly for nonlinear elliptic equations, and he obtained various kinds of pioneering results in this field up to now. The present research aims, based on the existent products for stationary problems, at further development of new verification techniques, including evolutional equations. As a final goal, it is expected to establish the computer assisted proof as an important methodology of mathematical analysis in this century.

【Expected results】

Various kinds of open problems for partial differential equations or dynamical systems related to complicated nonlinear phenomena, such as Navier-Stokes equation, Chaos etc., could be proved by computer assisted approaches. Also, in other science and technology, a new and great contributions by mathematics are expected in the reliability of numerical simulations through the mathematically rigorous estimates of error for approximation schemes, e.g., the finite element method and so on.

【References by the principal researcher】

・M.T.Nakao, K.Hashimoto, Y.Watanabe, A numerical method to verify the invertibility of linear elliptic operators with applications to nonlinear problems, Computing 75 (2005), 1-14.

・Y.Watanabe, N.Yamamoto, M.T.Nakao, T.Nishida, A numerical verification of nontrivial solutions for the heat convection problem, Journal of Mathematical Fluid Mechanics 6 (2004), 1-20.

【Term of project】 FY2008－2011

【Budget allocation】
65,300,000 yen (direct cost)

【Homepage address】 http://www2.math.kyushu-u.ac.jp/~mtnakao/