COMPLEX SYSTEMS MODELLING AND ITS APPLICATIONS

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We have been studying on complex phenomena from two distinct, but complementary and supplementary perspectives, namely generality and individuality, in our research project of the Aihara Complexity Modelling Project, ERATO, JST (Japan Science and Technology Agency). Regarding generality, efforts are made to formulate mathematical theory as well as analysis methodology for modelling complex systems, putting great emphasis on bifurcation analysis and nonlinear time series analysis. However, the inputs to make such theory are pursued by application studies of many individual real-world systems, from the viewpoint of mathematical engineering. Both aspects of generalized theory and individual systems analysis are necessary and indispensable. Thus, information is obtained from and fed back to a wide range of disciplines: nonlinear science, information science, life science, engineering, social science, and economics. The applications of the complex systems modelling include (1) dynamical computation of biological systems like neural networks and the brain ([1–5]), and genetic networks ([6–12]), (2) a new kind of computation by complex systems and its software, hardware and wetware implementations ([13–17]), and (3) modelling of diseases like novel pandemic influenza and prostate cancer, and mathematical analysis, e.g. on bifurcations peculiar to such hybrid systems models ([18–21]). These applications show that complex systems modelling and their mathematical analysis are useful for understanding, controlling, and harnessing various complex systems in this real world.

REFERENCES