TOWARDS COMPLEX SYSTEM THEORY

*Miroslav Svítek**

tutorial

Abstract: This tutorial summarizes the new approach to complex system theory that comes basically from physical – information analogies. The information components and gates are defined in a similar way as components in electrical or mechanical engineering. Such approach enables the creation of complex networks through their serial, parallel or feedback ordering. Taking into account wave probabilistic functions in analogy with quantum physics, we can enrich the system theory with features such as entanglement. It is shown that such approach can explain emergencies and self-organization properties of complex systems.

Key words: *Complex system theory, knowledge, quantum information systems, information power, information physics, self-organization, smart systems*

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1. Introduction

Information was interestingly described by George Bernard Shaw: "If you have an apple and I have an apple, and we exchange apples, we both still only have one apple. But if you have an idea (a piece of information) and I have an idea, and exchange ideas (this information), we each now have two ideas (two pieces of information)." Such example supposes our memory is a basis for system's specification: the *system* maps inputs into state values, and inputs and states into system's outputs.

Understanding the complex system is as if we were building a house. We need material (or mass), as well as plenty of workers (or energy), but without the knowledge of the plans as for when and how to build, we cannot erect the house. Information and knowledge are therefore the things that enrich the complex system theory and afterwards also natural sciences, enabling them to describe more faithfully the world around us.

The concept of data means a change of state, for example from 0 to 1 or from 1 to 0, where the state vector is not necessarily only digital or one-dimensional. Every such change can be described with the use of a quantity of *information* in bits.

*Miroslav Svítek, Czech Technical University in Prague, Faculty of Transportation Sciences, Konviktska 20, CZ-110 00 Praha 1, Czech Republic, Tel: +420-22435 9502, E-mail: svitek@fd.cvut.cz

