Adaptive systems and analyst-independent technologies

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This is a progress report based on my 2008 and 2009 talks at this Workshop, where I showed how ***structure*** is found in any ***partially ordered set*** when a suitable ***functional*** is minimized. I have now developed relevant mathematics for the observed phenomenon, and the conclusions are:

$$\textit{set + partial order} \rightarrow \textit{structure} \tag{1}$$

$$\textit{set + partial order + dissipative dynamics} \rightarrow \textit{emergent structure} \tag{2}$$

Equation (1) says that ***structure is in the information***. Equation (2) says that any dynamical process that dissipates the functional will cause the natural structure to emerge, thus explaining the phenomena of ***emergence*** and ***self-organization*** observed in all complex dynamical systems. These conclusions are key for the development of new adaptive, analyst-independent technologies.

Currently all our science and technologies are analyst-dependent, dominated by emergent structures produced by our brains [1], and only by our brains. They are analyst-dependent because they use, but do not replace the analyst's brain ability to find the emergent structures. But analyst-dependent technologies can not be fully automated. I have identified three technologies that have resisted full automation for decades, and all three are essential for advanced robotics.

(1) Software Engineering, particularly OO analysis, refactoring, and parallelism. The objects in a program are the structures that emerge from the analyst's brain. Such a program can never be adaptive, or intelligent, or fully automatic. However, a computer program is a partially ordered set of functions, the objects are the emergent structures, refactoring is the process of minimizing the functional, and parallelism is the reuse of resources. Equation (2) applies, and Software Engineering is the best candidate for full automation [2].

(2) Image recognition. Out of 100,000,000 dots of light, in 0.5 sec, the brain finds an identifiable image. The dots are the information, the brain does the dissipation, and the image is the emergent structure. Image recognition is also a good candidate for full automation.

(3) Artificial intelligence. Nature invented intelligence for adaptation. Adaptation is the key for understanding intelligence, and intelligent systems must be adaptive, and therefore analyst- independent. The automation of AI can be achieved by application of Eqs. (1) and (2).

But are robots adaptive? Are any of our AI systems adaptive, or even intelligent? Are our chess-playing, car-driving machines adaptive? These, and other similar questions are the focus of my talk.

[1] S. Pissanetzky. "Coupled dynamics in host-guest complex systems duplicates emergent behavior in the brain." WASET Proc., **69**, 927-935 (Aug. 2010).
[2] S. Pissanetzky. "A new universal model of computation and its contribution to learning, intelligence, parallelism, ontologies, refactoring, and the sharing of resources." Int. J. of Computational Intelligence, **5**, 143-173 (Aug. 2009).