ICEA

Integrating Cognition, Emotion and Autonomy

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Project summary (from 2005/06)

The ICEA project develops a cognitive systems architecture integrating cognition, emotion and autonomy (bioregulation and self-maintenance), based on the architecture and physiology of the mammalian brain. A key hypothesis underlying this four-year collaboration between cognitive scientists, neuroscientists, psychologists, computational modellers, roboticists and control engineers, is that emotional and homeostatic/autonomic mechanisms play a critical role in structuring the high-level thought processes of living cognitive systems.

The robots developed will perceive and act in the real world, learn from that interaction developing situated knowledge (representations of their environments in spatial, emotional and behavioural terms), and use this knowledge in anticipation, planning and decision-making. The brain and behaviour of the rat is an important starting point because of the large scientific literature available for this species. Rat cognition is studied and emulated both through an ambitious program of empirical studies in real animals and through computational modelling, at different levels of abstraction, on several, real and simulated, robot platforms.

The project develops two central, integrated platforms, rat-like in appearance, perceptual, and behavioural capacities. First, the ICEAbot robot platform, equipped with multimodal sensory systems serves as a real-world testbed and demonstrator of the behavioural and cognitive capacities derived from models of rat biology. Second, a 3-D robot simulator, ICEAsim, based on the physical ICEAbot, but also offering richer opportunities for experimentation, will demonstrate the potential of the ICEA architecture to go beyond the rat model and support cognitive capacities such as abstraction, imagination, and planning. ICEAsim serves as the main platform for exchange and technical integration of models developed in different parts of the project, but it will also be made freely available to the research community as a potential standard research tool. Other, more specialized robot platforms are developed to investigate issues of energy autonomy, to model active whisker touch, and to evaluate the ICEA architecture's applicability to non-biomimetic robots.

Summary of work in 2007 (from the activity report)

Much of the work during 2007 has been characterized by an increased focus on integration between groups and across work packages. For example, by now several work packages have implemented models and/or demonstrated results on the ICEAsim simulated rat platform, and in several cases the integration of computational models from different groups and work packages has been achieved. This also includes the replication of real-rat experiments in ICEAsim simulations. Furthermore, substantial progress has been made in the development of the different physical robot platforms, i.e. ICEAbot (cf. above), SCRATCHbot (active whisking/touch), and BREADbot (energy autonomy). Finally, substantial progress has also been made in developing an integrated cognitive systems architecture at different levels of biological detail, ranging from computational neuroscience models over a cognitive-robotic architecture to general control-architectural principles.