

**Emergence of Congruent Behaviour by Implicit  
Coordination of Innate and Adaptive Layers of  
Software Agents**



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## **Abstract**

The emergence of behavioural and structural congruence based on simple local interactions of atomic units is a fascination to the scientific community across many disciplines. The climax of behavioural congruence and emergence of behaviour is exemplified by the community life-style of ants. Each individual ant possesses the capability to solve only part of the overall puzzle while aggressively communicating in primitive methods with the spatially related neighbours to produce emergent behaviour. Hence, ant colonies have evolved means of performing collective tasks, which are far beyond the capabilities of their individual structures. The consensus is that comprehension of emergent complexity in insect colonies such as ants would serve as a good foundation for the study of emergent, collective behaviour in more advanced social organisms. As evidence of structural congruence, the realisation of a phenotype from a single genotype during the embryonic development, and some theories of the human mind that describe intelligence as a synergy of mindless constituents provide insight to the emergence theories. These facts argue that there exists a fundamental theory for structural and behavioural congruence that is yet to be discovered.

The primary hypothesis of the research is that the constituent atomic actions of a complex behaviour could be successfully coordinated by collaborative and autonomous agents that are loosely coupled through implicit communication to demonstrate emergent congruent behaviour in dynamic environments. The resulting congruent behaviour could be further optimised by using a hybrid learning approach that models adaptive behaviour on a static foundation of innate elementary behaviour.