C-08: Engineering design : a knowledge processing discipline

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Engineering is a practical discipline that is highly dependent on practitioner experience and judgement. However, engineering education, by and large, does not equip its graduates for the practice of engineering. This is because engineering education concentrates primarily on engineering science, which is characterised and formalised by numerical processing.

The Artificial Intelligence (AI) revolution has given much prominence to knowledge processing. This paper explores the possibility of knowledge processing being an alternative or complementary paradigm to that of numerical processing. The field of study investigated is structural engineering design. The activities and approaches involved in the above field are considered, and an evaluation made as to whether knowledge or numerical processing is the more appropriate paradigm.

Design processes can be categorised into case based design, decomposition and transformation. All of these categories are shown to be extremely knowledge intensive, concentrating as they do on knowledge elicitation, knowledge structuring and knowledge application respectively. The AI tools that can perform the above knowledge processing functions are artificial neural networks, blackboards and rule based production systems (or expert systems) respectively.

On the other hand, at the more routine and detailed levels of the design process, numerical processing becomes indispensable, as is demonstrated by the example of the design of a reinforced concrete frame. Here too however, knowledge processing can provide the context for preconditions to and constraints on numerical processing.

It is concluded that knowledge processing can and should provide a complementary paradigm to numerical processing, where engineering design is concerned. The AI tools for knowledge processing provide a formalism for the new paradigm.