C-09 Engineering design and synthesis: new inroads.

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Engineers design; engineering curricula, however, focus on analysis, and are therefore woefully inadequate. In analysis, we ask, "If these are the dimensions and this the description of a device, then how will it perform?".

The engineer who is designing, asks, "I want a device that would have such and such a performance. What should its dimensions be, and what is its description"?

How then do we train our engineers to be true problem solvers?. It was for long considered that design does not lend itself to formalism; that the ability to design is an innate character which some have and others lack. We teach students how an induction motor performs. But how do we teach how Ferrari and Tesla thought in creating it?

Recent developments in Mathematical Optimisation and Knowledge Based Intelligent Systems permit us to formalise creativity and construct a design tool that is capable of functioning autonomously. We will show that AI methods and mathematical optimisation together create a new environment for design where synthesis is natural and automated. Working with a mathematically formalised design criterion, we will show how design constraints can be incorporated in the design process. Where we deal with conflicting criteria (e.g,. the best machine that also need to be the cheapest), we show how fuzzy logic can be brought to bear in resolving the conflict. Neural networks are used to give a quick starting design which is then refined. Radical developments have occurred in the design process. Modern curricula must accommodate these developments.