Title: A Genetic Algorithm For Generating Capability Models

ABSTRACT:

It is important for engineers to understand the capabilities and limitations of the technologies they consider for use in their systems. Several researchers have investigated approaches for modeling the capabilities of a component or technology with the aim of supporting the design process. In these works, information about the physical form of a component or technology is typically abstracted away. The result is a model of the capabilities of the component or technology defined in the space of performance attributes. However, the complete set of feasible performance attributes for a given component or technology can be very large or even unbounded. By using Pareto frontier based methods, designers can limit their search to only those design alternatives that are nondominated (ignoring the alternatives that cannot be the most preferred). A practical limitation of Pareto based methods is that designers must have defined their preferences such that they are monotonic in each decision attribute. In many practical situations, a designer can formulate problems such that the monotonicity condition holds by defining the attributes appropriately. However, this reformulation is typically problem-specific and limits the reusability of the representation. Models based on parameterized Pareto frontiers—termed Technology Characterization Models (TCMs)—are much more reusable and composable. However, there exists no efficient technique for generating a model of the parameterized Pareto frontier. The contribution of this paper is a new algorithm for modeling the parameterized Pareto frontier to be used as a model of the characteristics of a technology. The proposed algorithm uses concepts from multi-objective optimization and machine learning.