

Injecting domain knowledge in multi-objective optimization problems: A semantic approach

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Resumen(Abstract). In the field of complex problem optimization with metaheuristics, semantics has been used for modeling different aspects, such as: problem characterization, parameters, decision-maker's preferences, or algorithms. However, there is a lack of approaches where ontologies are applied in a direct way into the optimization process, with the aim of enhancing it by allowing the systematic incorporation of additional domain knowledge. This is due to the high level of abstraction of ontologies, which makes them difficult to be mapped into the code implementing the problems and/or the specific operators of metaheuristics. In this paper, we present a strategy to inject domain knowledge (by reusing existing ontologies or creating a new one) into a problem implementation that will be optimized using a metaheuristic. Thus, this approach based on accepted ontologies enables building and exploiting complex computing systems in optimization problems. We describe a methodology to automatically induce user choices (taken from the ontology) into the problem implementations provided by the jMetal optimization framework. With the aim of illustrating our proposal, we focus on the urban domain. Concretely, We start from defining an ontology representing the domain semantics for a city (e.g., building, bridges, point of interest, routes, etc.) that allows defining a-priori preferences by a decision maker in a standard, reusable, and formal (logic-based) way. We validate our proposal with several instances of two use cases, consisting in bi-objective formulations of the Traveling Salesman Problem (TSP) and the Radio Network Design problem (RND), both in the context of an urban scenario. The results of the experiments conducted show how the semantic specification of domain constraints are effectively mapped into feasible solutions of the tackled TSP and RND scenarios. This proposal aims at representing a step forward towards the automatic modeling and adaptation of optimization problems guided by semantics, where the annotation of a human expert can be now considered during the optimization process.