

# Constraint-Based Support for Negotiation in Collaborative Design

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## Abstract

Solution spaces are proposed, instead of single solutions only, to support collaborative tasks during design and construction. Currently, partners involved in construction projects typically assign single values for sub-sets of variables and then proceed, often after tedious negotiations with other partners, to integrate these partial solutions into more complete project descriptions. We suggest the use of constraint solving to express possibly large families of acceptable solutions in order to improve the negotiation process in two ways.

On one hand, conflict detection can be performed in an automated manner. Through the constraints collaborators impose, they define large unfeasible areas where no solution to the problem at hand can be expected. An empty intersection of the solution spaces can thus point at a conflict of design goals of the different collaborators at an early stage of the design process.

On the other hand, important decision support during negotiation is provided. When a solution space is found, collaborators know during negotiation that they are negotiating about feasible solutions. Negotiation is no longer a means to find a solution to the problem but it takes place in order to find a good or the best solution. Since the consistency of the design remains ensured, collaborators are expected to be less restrictive towards innovative ideas during negotiation. Moreover, constraint techniques using explicit representations of solution spaces can provide tools to visualize trade-offs and illustrate the impact of certain decisions on other parameters. Thus decision-making is improved during the negotiation.

New algorithms have been developed at EPFL for solving multi-dimensional non-linear inequality constraints on continuous variables. Together with intuitive user interfaces such constraint-based support leads to better change management and easier implementation of least commitment decision strategies. It is expected that the results of this research can improve both the efficiency of negotiation processes and the quality of the achieved results.