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# A new loading problem: product size reduction

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## Abstract

This paper introduces a new kind of cutting and packing problem (C.P.P.): the Product Size Reduction (P.S.R.). The cutting and packing problems are widely studied as NP-hard problems. The cutting and packing problems can be set by using different models. To solve those problems, optimization algorithms, such as conventional heuristics, meta-heuristics and tree search, are

used. In addition, those algorithms may rely on positioning strategies. Usually, the loading problems are focused on logistics problems such as container or storage loading efficiency, whereas P.S.R. problems are related to electronics, transport and energy industries. The aim of this work is to solve a real case P.S.R. problem using a Particle Swarm Optimization (P.S.O.) algorithm. This case has two main features. First, all dimensions may vary between specific boundaries. Secondly, some objects have position constraints. A discrete space model has been built to simulate the objects loading. The optimization process is based on waterfalls objective-function (W.O.F.). Constraints are ordered and tested one after another. Depending on which constraints are fulfilled or not, a particular objective function is selected from a set. The P.S.O. algorithm manages to find a solution reducing significantly the volume.

**Keywords - Cutting and packing problem/Product size reduction/Waterfalls objective function/Optimization/Particle Swarm Optimization**