Over a decade ago, the European Journal of Operational Research published its first special issue on Cutting and Packing [1] in conjunction with the founding of SICUP, the Special Interest Group on Cutting and Packing. The majority of the papers in the first special issue were focused on cutting problems in the aluminium, paper, and canvas industry, as well as container loading problems. In 1995, a second special issue appeared [2]. As before, the issue included a number of papers on traditional one- and two-dimensional cutting stock problems and container/pallet loading problems, but it also reported new research in nesting problems and introduced the use of metaheuristics such as simulated annealing and genetic algorithms for solving packing problems.

Interest in solving these problems continues to grow: an increasing number of papers are being published in the literature each year on a range of cutting, packing, loading, and layout problems. Following the trend, this third special issue of EJOR reports current research that addresses a variety of cutting, packing and related problems where classical, as well heuristic approaches are applied.

A first cluster of papers is dedicated to one-dimensional cutting and packing. De Carvalho reviews several models for problems of the cutting stock and bin packing type and analyses the relationship between them as grounds for the development of branch-and-price algorithms. In the two succeeding papers, new methods for the generation of integer solutions to the one-dimensional cutting stock problem with different standard lengths are presented. Belov and Scheithauer introduced an exact approach which uses Chvatal–Gomory cutting planes to tighten up the continuous relaxation of the classic model formulation. Despite the impressive computational results given, the suggested method may still not be applicable to all practical problems due to its computational requirements. In such cases, the heuristic solution method developed and evaluated by Holthaus may represent a feasible alternative.

Important aspects of many real-world problems are considered in another two papers. Zak looks at cutting processes which extend over several stages. He proposes a solution method which is based on the classic column-generation procedure by Gilmore and Gomory and dynamically generates both rows (intermediate sizes) and columns (cutting patterns). However, the method does not guarantee that an optimal solution is found. In practice, the question of how to cut down orders from stock lengths is often interconnected with the problem of sequencing the cutting patterns in the most economical way. Armbruster describes such a problem at a steel service centre and suggests a
heuristic aimed at the generation of a feasible pattern sequence, which in this particular case – due to specific technical constraints – is often difficult to identify. Unlike other approaches to the pattern sequencing problem, this one also considers changes to the original set of patterns.

A second cluster of this special issue is formed of papers related to two-dimensional cutting and packing. Among these papers is the invited review by Lodi, Martello, and Monaci, in which the authors present latest developments in the areas of two-dimensional bin packing, strip packing, and level packing, i.e., they concentrate their survey on problems, in which all small items have to be accommodated. All small items are rectangles and cannot be rotated. The authors discuss models for these problems, bounding techniques, classic approximation schemes, meta-heuristics and exact enumeration approaches. Wu et al. introduce the rectangle packing problem in which it has to be decided whether a set of small rectangles can be packed into a larger rectangle of fixed size. This problem has practical applications in VLSI floor planning and scheduling, among others. For its solution, the authors propose a heuristic which is based on what they call “The Less Flexibility First Principle”.

Two more papers on two-dimensional cutting and packing consider the nesting problem. This is a (strip) packing problem in which non-regular or even irregularly shaped small items have to be packed into a large rectangle of fixed width and minimal length. Gomes and Oliveira investigate the design of a new heuristic based on a 2-exchange neighbourhood generation strategy. Several variants of the heuristic were implemented and the best one identified in numerical experiments. In the paper by Dowsland, Vaid, and Dowsland a fast and efficient implementation of a bottom-left placement algorithm for polygons is introduced. A special feature of this method is that it allows small items to be nested within the layout produced by previously placed items.

The final cluster consists of four papers on cutting and packing in three and more dimensions. In the paper by Pisinger the (single knapsack) container loading problem is considered: a subset of a given set of rectangular boxes has to be packed into a rectangular container of fixed dimensions such that the value of the packed boxes is maximized. The author introduces a new heuristic based on the wall-building approach, which decomposes the problem into a number of layers which again are split into a number of strips. Eley also addresses the container loading problem, however, instead of using wall, layer, or tower arrangements, the container is filled by homogeneous blocks of identical boxes. Lodi, Martello, and Vigo treat the bin-packing variant of the three-dimensional problem type, i.e., a container loading problem in which a given set of rectangular boxes is to be packed into a minimum number of rectangular containers of identical size. They introduce a new approximation algorithm and discuss its use in a Tabu Search framework. A generalization of the (rectangular) packing problem into $n$ dimensions is introduced in the paper by Lins, Lins, and Morabito. For this problem the authors introduce a recursive procedure which is based on the representation of a feasible packing as a depth assignment in a sequence of $n$ directed graphs. Computational experience is reported for the three-dimensional case.

Most of the authors of this volume are members of SICUP. Earlier versions of their work have been presented and discussed at the group’s workshops which are usually organized as a part of a large international OR conference of EURO, INFORMS, or IFORS. Practitioners and researchers in the area of cutting and packing who are interested in joining SICUP should contact the chairman of the group, Professor José Fernando Oliveira, INESC, Porto (e-mail: jfo@fe.up.pt). Further information is also available at SICUP’s web page (http://www.apdio.pt/sicup/).

References