Clustered strip packing benchmark instances

Rosephine Georgina Rakotonirainy and JH van Vuuren

Department of Industrial Engineering, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa

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We have clustered a large, representative set of strip packing benchmark instances from various repositories in the literature into different classes of test problems based on their underlying features. This document contains a brief description of the characteristics of these clustered benchmark instances. Lists of the benchmark instances contained in each class, as well as hyperlinks to text files containing all the benchmark instances, are also provided. These clustered benchmark instances may be used to test algorithmic approaches towards solving the strip packing problem.

1 Strip packing benchmark instances

Two classes of strip packing benchmark instances were considered. Benchmark instances in the first class are zero-waste problem instances for which optimal packing solutions are known and do not contain wasted areas (areas of the strip not occupied by items). This class of problem instances contains nine data sets, including the J instances of Jakobs [1], the SCP instances of Hifi [2], the babu instances of Babu [3], the NT and T instances of Hopper and Turton [4, 5], the N instances of Burke *et al.* [6], the CX instances of Pinto and Oliveira [7], and the IY instances of Imahori and Yagiura [8]. The second class of benchmark instances are non-zero-waste instances for which optimal solutions are not known in all cases and others for which optimal solutions are known, but involve some wasted regions. This second class of benchmark instances contains eleven data sets, namely the cgut instances of Christofides and Whitlock [9], the beng instances of Bengtsson [10], the gcut and ngcut instances of Beasley [11, 12], the bwmv instances of Berkey and Wang [13] and of Martello and Vigo [14], the DP instances of Dagli *et al.* [15, 16], the BK instances of Burke and Kendall [17], the SCPL instances of Hifi [18], the nice and path instances of Wang and Valenzela [19], the AH instances of Bortfeldt and Gehring [20], and the zdf instances of Leung and Zhang [21].

2 Charactersitics of the clustered benchmark instances

The instances presented in §1 were grouped into different categories based on the following features: The *maximum aspect ratio*[1] of all items of an instance, the *maximum area ratio*[2] of

[1]The aspect ratio of an item is the ratio of its larger side dimension to its smaller side dimension.

[2]The maximum area ratio of all pairs of items of an instance is the ratio of the maximum area of all items to the minimum area of all items.

all pairs of items of an instance, the *heterogeneity ratio*[3], and the *width ratio*[4]. The maximum aspect ratio allows one to gain information on the shapes of the items in an instance, whereas the variety in the sizes of the items in an instance may be deduced from the maximum area ratio. The miscellany of items in an instance may be gauged from the heterogeneity ratio, while the width ratio characterises the mean item width relative to that of the strip.

A cluster analysis was performed in respect of the benchmark instances based on the aforementioned factors. Four benchmark clusters were obtained accordingly. Table 1 contains a summary of the underlying characteristics of each benchmark cluster. The first cluster is predominantly populated by instances with narrow items of elongated rectangular shape, which are widely varying in size. Instances in the second cluster contain a large number of wide items and are predominantly homogeneous. The third cluster is composed of instances containing items of an approximately square shape, which are relatively small compared to the strip width. Some of the items in the instances are of the same type. Instances that belong to the last cluster are dominated by approximately square items that are fairly similar in size. The lists of instances contained in each cluster may be found in [22]. All benchmark instances may also be downloaded from [22].

Factors	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 4**
Heterogeneity Ratio	Strongly heterogeneous	Significantly homogeneous	Significantly homogeneous	Heterogeneous
Width Ratio	Predominantly narrow items	Predominantly wide items	Predominantly narrow items	Predominantly wide items
Maximum Area Ratio	Predominantly uneven sized items	Predominantly uneven sized items	Predominantly equally sized items	Predominantly equally sized items
Maximum Aspect Ratio	Predominantly rectangular items	Predominantly rectangular items	Predominantly square items	Predominantly square items
Total	321	740	251	406

Table 1: Characteristics of the clustered benchmark instances according to the different factors. The row labelled 'Total' contains the number of instances included in each cluster.

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[3]The heterogeneity ratio refers to the number of types of items, where two items are of the same type if they have identical dimensions.

[4]The width ratio is determined as the ratio of the strip width to the mean value of all items' dimensions.

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