

# Automatic Topology Detection and Adaptive Triangulation of 2D Regions without Boundary Intersections Using the Meccano Method

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## ABSTRACT

This work introduces new advances in the automatic generation of triangulations based on the Meccano method [1]. In particular, a new strategy is developed to replace the demand of a user-provided meccano with its unsupervised construction, suitable for 2D regions without boundary intersections.

We first create a coarse quadtree from the given polyline definition of the boundaries of the regions. This quadtree is adaptively refined, while enforcing a specific set of properties to unambiguously infer the topology; this quadtree segmentation defines the initial meccano for the whole domain. Thereafter, the Meccano method is applied: (i) piecewise bijective map definition from the each boundary of the regions to its counterpart in the meccano, (ii) Kossaczky refinement to approximate the boundaries with a given tolerance, and (iii) SUS mesh optimisation to obtain a valid high-quality mesh. In addition, refinement strategies are introduced to improve the initial meccano.

This procedure allows the Meccano method to automatically generate meshes for arbitrary geometries. In comparison with other standard techniques, such as Delaunay triangulation or advancing front, our method can generate meshes with better quality for a similar number of elements that are not affected by the discretisation of the polyline boundary definition [2]. Applications are presented to show the advantages of the proposed technique.

## REFERENCES

- [1] J. M. Cascón, R. Montenegro, J. M. Escobar, E. Rodríguez, and G. Montero, The Meccano Method for Automatic Tetrahedral Mesh Generation of Complex Genus-Zero Solids, *Proceedings of the 18th International Meshing Roundtable*, pp. 463–480, 2009.
- [2] J. M. Cascón, E. Rodríguez, J. M. Escobar, and R. Montenegro, Comparison of the meccano method with standard mesh generation techniques. *Engineering with Computers*, Vol. **31**, no. 1, pp. 161–174, 2013.