# Algorithms for Multi-Criteria Mesh Partitioning

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Perfectly load-balance numerical simulations is mandatory to achieve good efficiency on large scale computers. For mesh based simulations, in distributed memory, it generally relies on finding a mesh partition, such as each part of the same corresponds to the same computational cost. Moreover, this partition is also chosen to minimize the communications between the parts during the computations. This partitioning approach is a NP-Hard problem, but in practice, heuristics provide decent results.

For multi-physics and multi-steps simulations, load-balance have to be achieved for each phase: we thus have to perform a multi-criteria partitioning. However, current heuristics are less adapted for this problem than for mono-criterion: often they do not find a balanced partition.

In this talk, we will present our work on multi-criteria mesh partitioning, especially by designing heuristics that find balanced partition, for all criteria at the same time. Like other partitioners such as ParMetis or PaToH, we use a multi-level algorithms, to solve a hierarchy of partitioning problems. The idea of these algorithms is the same than the principle of multi-grids for linear solvers: we reduce the problem size doing a coarsening of the graph, we solve a small problem and we project and refine the solution. However, while other partitioners relax the balance constraint during the refinement, in our method we can ensure that we will maintain the balance at each level. We will present experimental results we obtained with our multi criteria algorithms implemented in Scotch.

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