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LOAD BALANCING FOR *HP*-ADAPTIVE DISCONTINUOUS GALERKIN METHODS

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Summary.

The accurate numerical simulation of turbulent flows can present prohibitive computational cost due to the chaotic three-dimensional mixing behavior and the wide range of spatial and temporal scales that are present in the flow. A significant reduction of the computational cost of such simulations can be achieved by employing Large Eddy Simulations (LES) in combination with efficient discretization schemes with favorable dissipation and dispersion properties. For this type of applications, the high-order Discontinuous Galerkin (DG) method[1] has been gaining a growing amount of interest among the scientific community. One particularly relevant property of the DG method is the possibility of reducing the computational cost of simulations by adapting the spatial resolution by either modifying the local mesh size (*h*-adaptation) or by modifying the local order of the method (*p*-adaptation). In order to preserve the high parallel efficiency of the DG method in the case of *hp*-adaptive simulations, specific load balancing strategies must be developed which take into account the non-uniform distribution of the computational cost. This requires in general the accurate definition of the communication cost and of the computational cost, or computational weight, to be associated to each element of the computational domain.

One possible approach for the definition of the computational weight consists in defining *a-priori* estimates from the theoretical operation count. Despite its application in previous works[2,3,4], we show in this work that this strategy does not provide a methodology to reliably specify the computational weights used by the graph partitioning algorithm to obtain well-balanced simulations. Nonetheless, the results of this analysis can be employed to aid the definition of the computational cost estimates based on direct measurements of computational times. A more robust computational weight definition is therefore derived for *hp*-adaptive DG simulations. Numerical tests are carried out to demonstrate the improved load-balancing of mesh partitionings obtained using the proposed strategy. Finally parallel p-adaptive DG-LES simulations of the transitional flow past an airfoil are performed demonstrating the applicability of the developed strategy on configurations of practical industrial interest.

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