Comparison of the element and the nodal based parallel implementations of the dynamic relaxation method

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Abstract

The dynamic relxation method is used for the form-finding and the analysis of cable-membrane structures. The method requires several hundreds or even thousands of steps to converge to the final solution, thus to speed-up the design and analysis steps it has been implemented in parallel [1]. The first parallel implementations were element based. This means that the final element mesh of the structure is divided based on elements. In this way one element is calculated by one computer and the nodes are duplicated on different computers along the boundary of the division. However recently the Graphical Processing Units (GPUs) in computers became very powerful computational resources, which attracted a lot of attention. The dynamic relaxation has also been implemented on GPUs, but the algorithm of the method had to be changed [2]. In this case one computation unit in the GPU calculates the equilibrium of one node in the finite element mesh. This is the nodal based approach. As a consequence of this approach, the finite element equations will be calculated on more than one computational units, therefore duplicating the computational work. On the other hand these calculations are independent from each, which should provide good parallel execution efficiency on GPUs. This paper discusses the two different parallel implementations and it compares the two approaches in terms of their efficiency and speed of calculation.

References

[1] B. H. V. Topping and P. Iványi, *Computer Aided Design of Cable Membrane Structures*, Saxe-Coburg Publications, 2007.

[2] P. Iványi, CUDA accelerated implementation of parallel dynamic relaxation, *Advances in Engineering Software*, vol. 125, pp. 200-208, 2018.