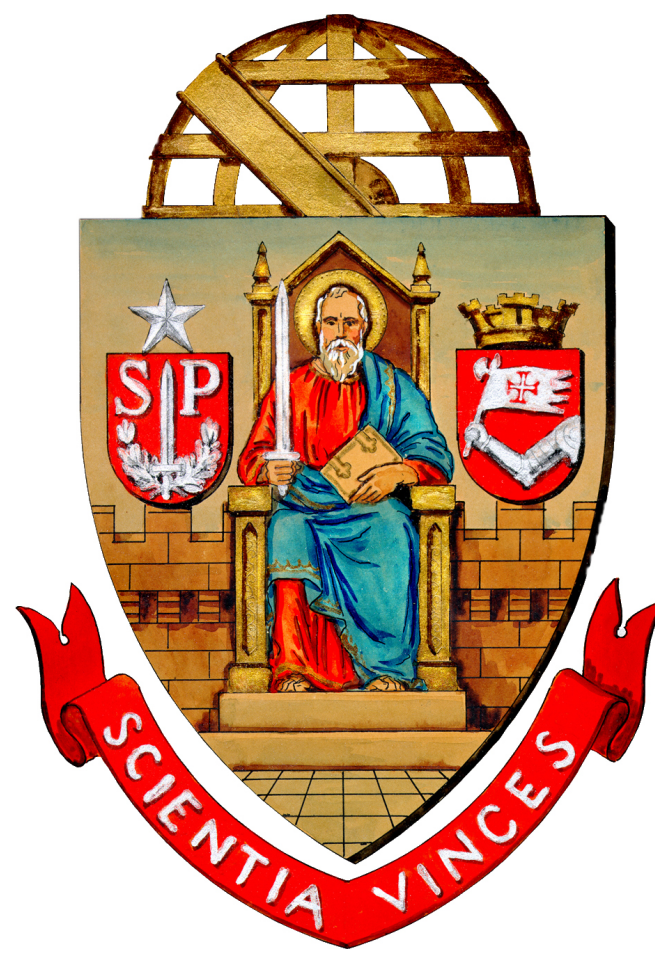




Optimizing a Boundary Elements Method for Stationary Elastodynamic Problems Implementation with GPUs



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Introduction

- ▶ The Boundary Element Method (BEM) is a very efficient alternative for modeling unlimited domains.
- ▶ This method can be used for numerically modeling the stationary behavior of 3D wave propagation in the soil. [1]
- ▶ It can be used for analyzing the vibration created by heavy machines, railway lines, or earthquakes.

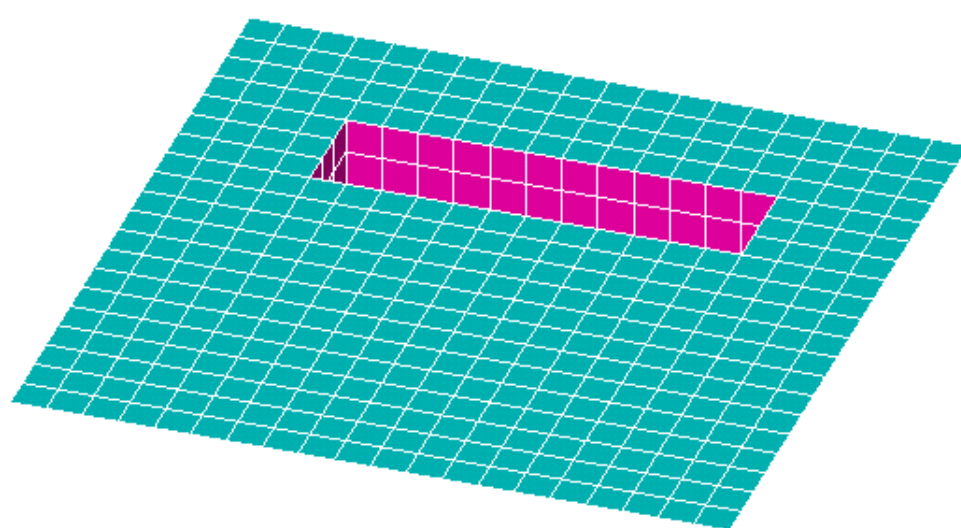


Figure: Example of a surface.

BEM Formulation Background

- ▶ Boundary Integral Equation for Stationary Elastodynamic Problems [2]:

$$c_{ij}u_j(\xi, \omega) + \int_S t_{ij}^*(\xi, x, \omega)u_j(x, \omega)dS(x) = \int_S u_{ij}^*(\xi, x, \omega)t_j(x, \omega)dS(x)$$

- ▶ After performing the geometry discretization, above equation can be represented in matrix form as $Hu = Gt$.
- ▶ Numerically, these integrals can be computed using the Gaussian quadrature.

Objectives

- ▶ Bring a legacy implementation of BEM for Stationary Elastodynamics Problems to a contemporary computing scenario, enabling the usage of multicore processors and GPUs.
- ▶ Accelerate the overall performance to simulate surfaces with a higher number of mesh elements

Results

We applied the paralelization approach described in [3] together with MAGMA's LU decomposition.

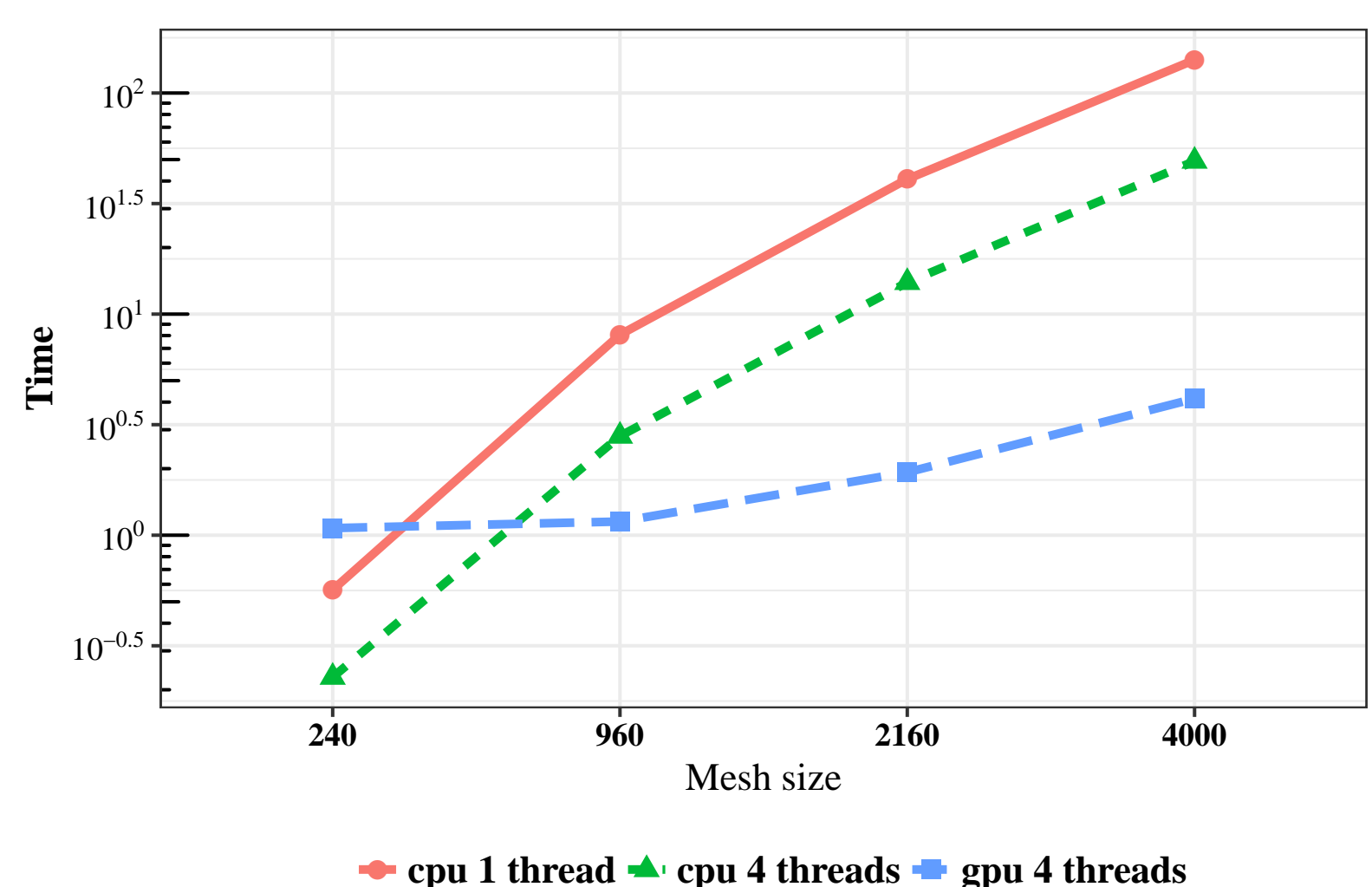


Figure: Total elapsed time in a AMD A10-7700K paired with a GeForce GTX 980

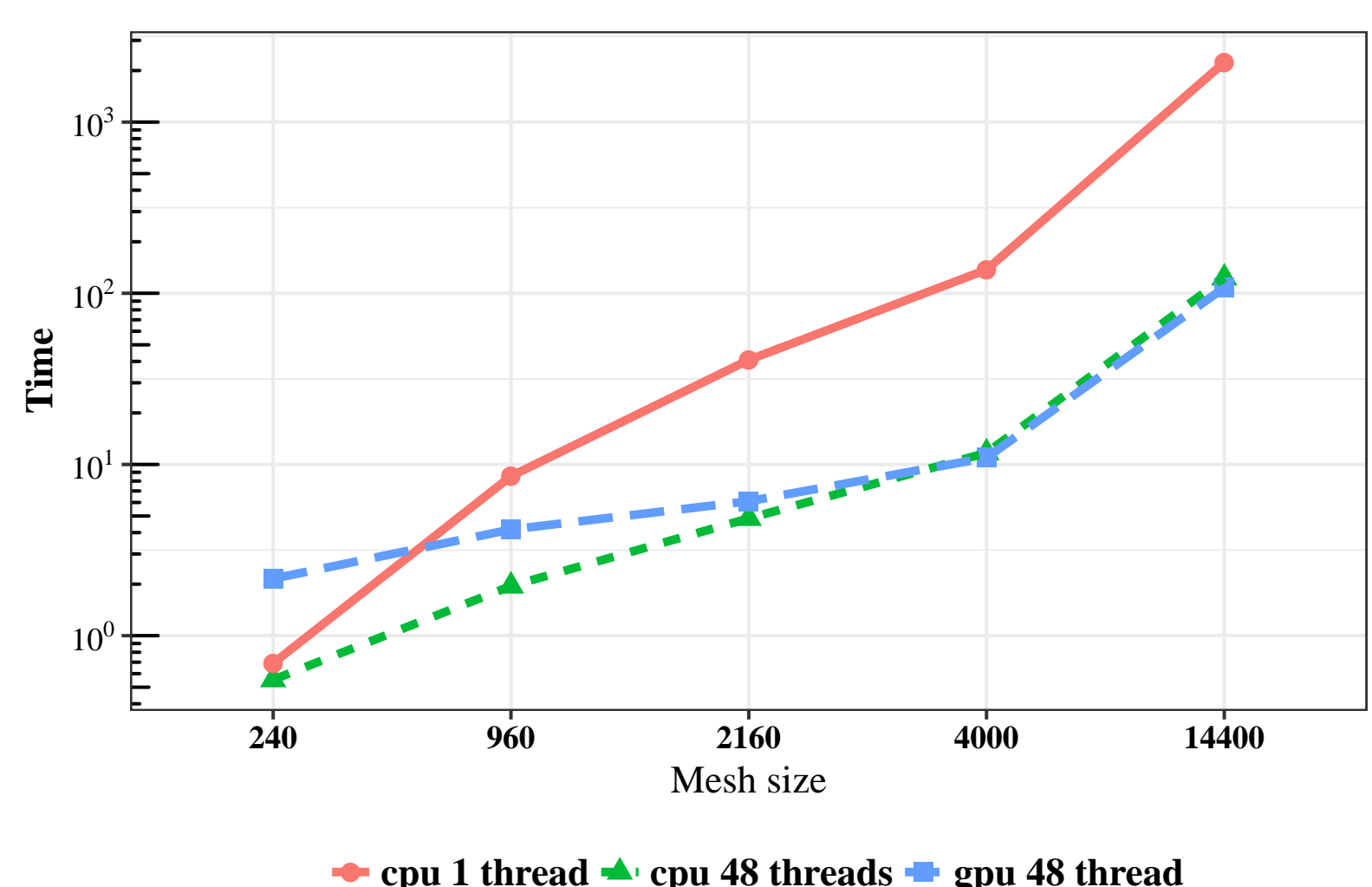


Figure: Total elapsed time in a 2x Xeon E6-2650 v4 paired with a Tesla K40

Conclusions

- ▶ Better speedups can be obtained if a load balancer is implemented. The current implementation does not use both CPU and GPU simultaneously.

References

- [1] John T Katsikadelis. *The Boundary Element Method for Engineers and Scientists: Theory and Applications*. Academic Press, 2016.
- [2] Ronaldo Carrion. *Uma Implementa do Mdo dos Elementos de Contorno para problemas Viscoelastodinicos Estacionos Tridimensionais em Domos Abertos e Fechados*. PhD thesis, Universidade Estadual de Campinas, 2002.
- [3] Giuliano AF Belinassi, Rodrigo Siqueira, Ronaldo Carrion, Alfredo Goldman, and Marco D Gubitoso. Optimizing a boundary elements method for stationary elastodynamic problems implementation with gpus. *WSCAD-WIC 2017*, page 51.