An Implementation and Evaluation of a Co-rotational Finite Element Method on Mobile Architectures

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Finite element methods (FEM) have been an active area of research for physical simulations over the last 30 years. FEM is mainly used to simulate deformation and fractures of solid objects. Its application is of particular interest in engineering and scientific fields, where accuracy is more important than plausibility. However, due to its complexity, it is only suitable for offline simulations. Notwithstanding these limitations, FEM can be used for interactive applications. Earlier work has shown the feasibility to run FEM in real-time contexts, on limited console hardware, using linear tensors. Instability problems, which arose from the use of linear approximations, were successfully addressed using a co-rotational formulation.

This dissertation explores the viability of achieving a robust and real-time FEM implementation on mobile architectures. A co-rotational FEM is fully implemented on both CPU and GPU hardware. Experiments are conducted to benchmark and to evaluate the efficiency of memory hierarchy on the Tegra architecture. The results are promising, showing interactive frame rates on both CPU and GPU implementations.