USING 3D GESTURE CONTROLS FOR INTERACTING WITH MECHANICAL MODELS

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This work investigates how advanced finite element analysis can be used in the early design stages in architectural and industrial design. This requires changes in user interface design as well as in algorithm design for the numerical code. In the early design stage, requirements of the applications are often quite different from the final design stages. Often many designs needs to be evaluated and the speed of developing and evaluating a design is the most important aspect. In this project we have tried to make the finite element analysis an integral part of the design tool, eliminating the discrete steps of pre-processing, solving and post-processing. Example of an application using this approach is Sketch-A-Frame [1], a 2D beam element FE-application for the iPad, in which the user quickly can design a structure and immediately see the response and forces in the structure in real-time. This approach gives the user a strong feeling of directly manipulating the model and understand the behavior of the structure. It also encourages the user to explore different designs in a quick and efficient way.

To develop this approach further and increase the depth of the interaction, the approach was implemented in a 3D beam model. An earlier developed finite element code, ObjectiveFrame [2], was adapted to support the direct manipulation approach by modifying the finite element solver to continuously calculate the structural responses and forces. However, the intuitive interaction with the 3D beam model was difficult to achieve using a 2D pointing device such as a mouse. To solve this, the Leap Motion controller [3] was integrated in the application. Leap Motion is a relatively new controller, enabling the user to interact with the application in three dimensions. The controller tracks finger, hand and tools and allows the user to directly interact with the computer in three dimensions. This controller enabled us to provide similar direct interaction with the model as in the simpler 2D touch application, Sketch-A-Frame. A lot of experimentation was done to develop the needed gestures and interaction models needed for creating an intuitive user experience interacting with the model. A completely gesture based approach proved to

be not so easy to use. A combination keyboard and Leap Motion combines the strength of the two input devices, 3D input from the controller and the precision and speed from the keyboard.

Another important part of this work is to improve the efficiency of the finite element analysis enabling real-time analysis of more complex models. In the developed conceptual tools the finite element solvers are more tightly integrated in the interactive model, to eliminate any unnecessary data communication. We are also working on a new solver architecture taking advantage of multi-core architectures as well as GPU and accelerators.

REFERENCES

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[3] Leap Motion *http://www.leapmotion.com*