Finite Element Implementation of Peridynamics

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Peridynamics [1] has been one of the most popular techniques in failure prediction during the recent years. As new researchers start to learn the peridynamic concept and make their own contributions, the application areas of peridynamics are widening. As opposed to partial differential equations of classical continuum mechanics, peridynamics are based integro-differential equations. These equations are usually difficult to solve by using analytical techniques. Instead, meshless techniques have been widely used for the solution process. Hence, the solution domain is divided into finite number of small volumes without using mesh connectivity as in finite element method.

There is currently no commercial software based on peridynamics which limits its usage especially in industry. A reasonable approach to overcome this issue is to implement peridynamics in commercial finite element softwares although these two approaches are fundamentally different. Macek and Silling [2] proposed an approach and suggested that regular finite elements can represent peridynamic interactions and inertia of material points. It is also straightforward to eliminate elements if failure occurs. Such an approach brings several advantages. First of all, commercial finite element softwares usually have very good and efficient solvers. Moreover, the software can directly allow utilisation of multi-processing which is especially important if high performance computing capabilities (HPC) are available. Both of these features can significantly reduce the computational time which is especially crucial for 3-Dimensional peridynamic simulations. Finally, this process allows engineers and researchers at industrial companies quickly adapt the peridynamic logic and start using for their analyses. Therefore, in this presentation, an overview of the implementation of peridynamics in commercial finite element softwares will be presented.

References

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