

A framework for developing finite element codes for multi-disciplinary applications

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ABSTRACT

The objective of this article is to explain the structure of a framework for building multi-disciplinary finite element programs. Generality, reusability, extendibility, good performance and memory efficiency are considered to be the main points in design and implementation of this framework. Preparing the structure for team development is another objective because usually a team of experts in different fields are involved in the development of multi-disciplinary code.

Kratos, the framework created in this work, provides several tools for easy implementation of finite element applications and also provides a common platform for natural interaction of its applications in different ways. To achieve this, an innovative variable base interface is designed and implemented which is used at different levels of abstraction and showed to be very clear and extendible. A very efficient and flexible data structure and an extensible IO are created to overcome difficulties in dealing with multi-disciplinary problems. Several other concepts in existing works are also collected and adapted to coupled problem. Examples are using an interpreter, different data organizations and variable number of dofs per node. The kernel and application approach is used to reduce the possible conflicts arising between developers of different fields and layers are designed to reflect the working space of different developers also considering their programming knowledge. Finally several technical details are applied in order to increase the performance and efficiency of Kratos which makes it practically usable. This work is completed by some examples demonstrating the framework's functionality in practice.