# Parallel Multiphysics Simulation for the Stabilized Optimal Transportation Meshfree Framework

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## ABSTRACT

Meshfree methods provide a flexible approach to study fusion, cutting processes and free surface flows comparing to meshbased schemes like the Finite Element Method having a fixed connectivity between the nodes.

In this paper, parallel implementation of the Stabilized Optimal Transportation Meshfree (OTM) method is discussed [2]. In the original OTM method an additional algorithm for a nodal rearrangement is required to ensure stable computation. But, in the Stabilized OTM method the origin for the unphysical movement of the original version is identified and diminished by using stabilization. The final solution scheme ensures an improved accuracy and avoids additional computational efforts. In the OTM method, the domain is subdivided into two different types of points: Nodes and Material points. The connection is determined by a search algorithm and both points are updated during the calculation. The search algorithm is computational intensive leading to large computational time [2].Parallel algorithms are implemented using Message Passing Interface (MPI) with an objective to reduce the computational time. The initial static domain decomposition is done by distribution of the material points and nodes using Recursive Coordinate Bisection (RCB) method. Challenges were involved in developing the communication architecture across the processors for the nodal and material point updates. Due to unstructured subdomains, challenges were also involved to ensure unique update of nodal variables, which were common to multiple elements across different processors. The overlap among subdomains in different processors is determined by the shared nodes common to multiple elements across processors during the searching process. Comparing to the approach by Ortiz[3] in which search algorithm is implemented locally at each processor , the search algorithm in the current approach is implemented across multiple processors. Parallel performance analysis, such as the speed up factor on multiple cores is investigated in several multiphysics applications. The results are compared with the performance on a single core.

## REFERENCES

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