

# **Stabilized Updated Lagrangian SPH for Hyperelastic material**

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## **ABSTRACT**

A total Lagrangian formulation for the smoothing particle hydrodynamics (SPH) proposed by Bonet and Kulasegaram[1] is a robust numerical method for large distortion problems. However, updating the reference configuration is often required in some problems including very large distortions. However, an updated Lagrangian formulation that is extended from the total Lagrangian formulation suffers from zero-energy modes. Vidal et al.[2] succeeded to stabilize the numerical instability of the update Lagrangian formulation using stabilized terms like artificial viscosity. The stabilized term works well but includes indeterministic parameters that depend on problems. Therefore, to avoid zero-energy modes, we proposed new formulation for SPH with an update Lagrangian that does not include nonphysical parameters. The main idea of our proposed method is that we compute a deformation gradient from a gradient of deformation gradient. The high order term restricts numerical instability and improves accuracy. To check the validity, we solved three problems, bar extension problem, rings collision problem and cylinder oscillation problems. The results show good agreements with results obtained from the total Lagrangian formulation.

## **REFERENCES**

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