Application of the SPH Finite Element Method to Evaluate Pipeline Response to Slope Instability and Landslides

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Buried pipelines operating in active slopes can be subject to lateral and axial loads resulting from slope instability and landslides. The techniques to predict pipeline displacements, loads, stress or strains are not well described in design standards or codes of practice. The practice of using finite element analysis of soil-pipe interaction has developed in recent years and is proving to be a useful tool in evaluating the pipeline behavior in response to slope movement.
A description of BMT advanced pipe soil interaction modeling techniques, their validation against full scale trails and comparison to spring support models has been previously published.

This paper describes the modeling techniques and demonstrates the application and versatility of LS-DYNA 3D continuum SPH (Smooth Particle Hydrodynamic) model to examine the pipeline behavior and evaluate the pipeline strain demand in relation to key parameters. This includes the effect of soil movement mechanism, pipeline geometry (D/t), material grade and soil conditions and properties.

The application and results are used to illustrate an advanced soil structure interaction numerical simulation technique combining the LS-DYNA nonlinear SPH formulation with Lagrangian formulation while satisfying all the principles of continuum mechanism.