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rdbsp: An Open Source Rock Dynamic Behavior Simulation Program

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Software

- Review
- Repository
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Summary

Rock dynamics has become one of the most important topics in the field of rock mechanics and rock engineering. The spectrum of rock dynamic behavior widely includes phenomena of rockbursting, spalling, popping, collapse, toppling, sliding, and so on, which induced by the stress redistribution and energy release after excavation (Aydan, 2017). Current version of rdbsp arms to simulate the process of displacement field redistribution and stress wave propagation in deep underground rock with finite element method(Wang, Zhang, Li, Ma, & Fan, 2015). Forward Euler time integration scheme is adapted in this program to simulate the dynamic procedure (Ascher, Chin, & Reich, 1994). The elastic constitutive model and Mohr-Coulomb plastic model are implemented in this version (Ottosen & Ristinmaa, 2005).

To speed up the simulation as well as overcome the over-stiff effect of fully integrated element during dynamic simulation (Zienkiewicz, Taylor, & Zhu, 2013), three-dimensional solid element type with a single integration point is implemented. Zero energy modes so called hourglass effect could be happeaned for single point integrated element, the hourglass resistance is applied to eliminate that effect (Flanagan & Belytschko, n.d.). The Jaumann derivative is added into the program with the concern of the effect of the rigid body rotation to solve the difficulty of the large deformation calculation for the deep rock mass (Valanis, 1990). For dynamic analyses, Rayleigh damping and artificial viscosity are also available to control damping. With the local nonviscous damping rdbsp could also obtain the static results of a rock mass excavation (Cundall, 1987). The system converges to the steady state is controlled by the ratio of total unbalance force and nodal mass. The finite element model can be generated by the Hypermesh via the tempate of DYNA3D with minor change. The results of simulation could be exported for Paraview (Kitware, 2018)and Tecplot (Tecplot, 2018).

rdbsp is a fully fountional simulation program with modules of input file interpretation, memory management, and node/element index remapping. The working flow of rdbsp is showin in the following figure. A sample test of quarter symmetrical circle tunnel excavation project input file is included in source file.

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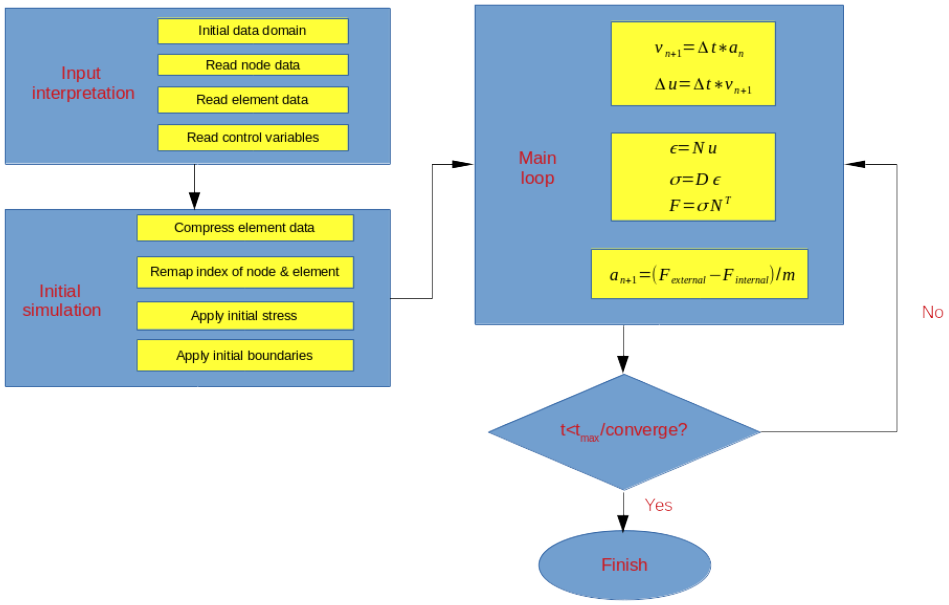

Figure 1: Working flow of rdbsp.

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