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We have implemented the Staggered-Grid Split-Node (SGSN) Method, proposed by Dalguer and Day (2006), in the Message Passing Interface (MPI) Finite Difference code of the TeraShake platform. The SGSN was formulated to adapt the traction-at-split-node method in the velocity-stress staggered-grid finite difference scheme. This method provides an efficient and accurate means for spontaneous dynamic rupture simulation. The target of the implementation of the SGSN in the TeraShake platform is to develop reliable large scale dynamic rupture simulations. Based on comparisons with the established Dynamic Fault Model (DFM) results with very high resolution (Day et al., 2005), we have verified the suitability of the SGSN code implementation by testing the spontaneous rupture problems Version 3 and 5 of the Southern California Earthquake Center (SCEC) benchmark problems, and a bimaterial-interface problem of the model Version 3. As shown in the figures, the rupture time and the time histories of slip rate, slip, shear stress and normal stress (at points marked at Figure 1) of DFM0.05 and SGSN0.1 solutions are virtually identical. We have also verified the scalability of the computational time (Figure 4) using the super computers of the San Diego Supercomputer Center. The SGSN code scales nearly perfectly in computing time up to at least 1296 processors using the Datastar cluster.

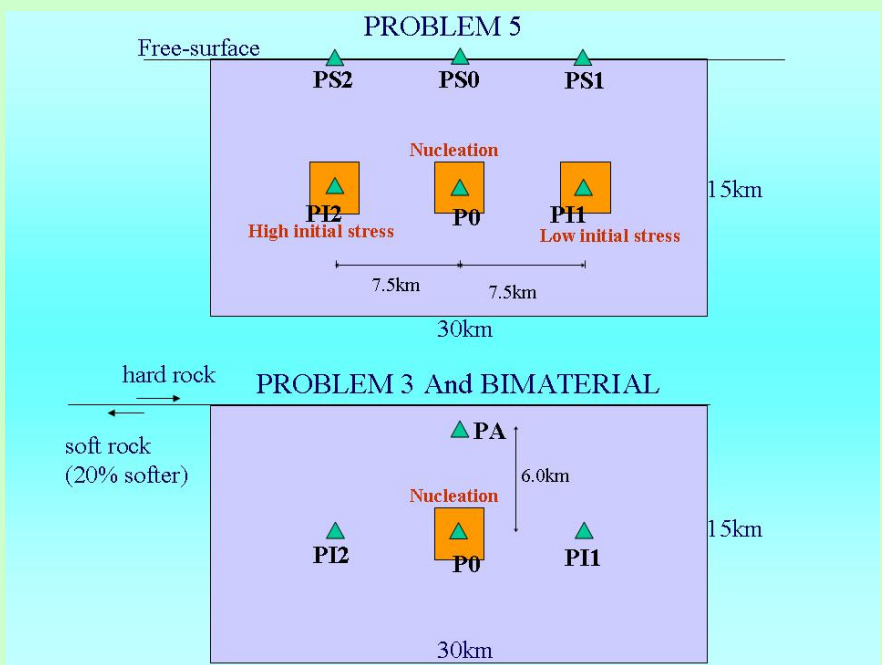


Figure 1. Fault models of problem 5 (top) and problem 3 (bottom) of the Southern California Earthquake Center (SCEC) benchmark problems. The problem version 3 was adapted for a bimaterial-interface problem, modifying the material of one side of the fault to 20% softer

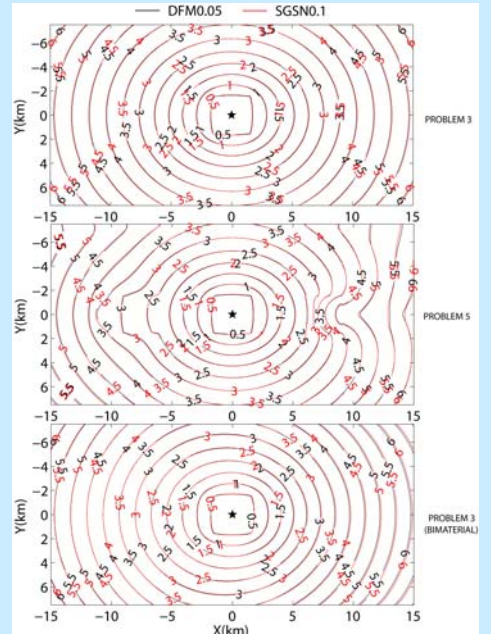


Figure 2. Contour plot of the rupture front for problem 3 (top) and problem 5 (middle) and bimaterial (bottom). Red curves are for SGSN0.1 and black curves for DFM0.05.

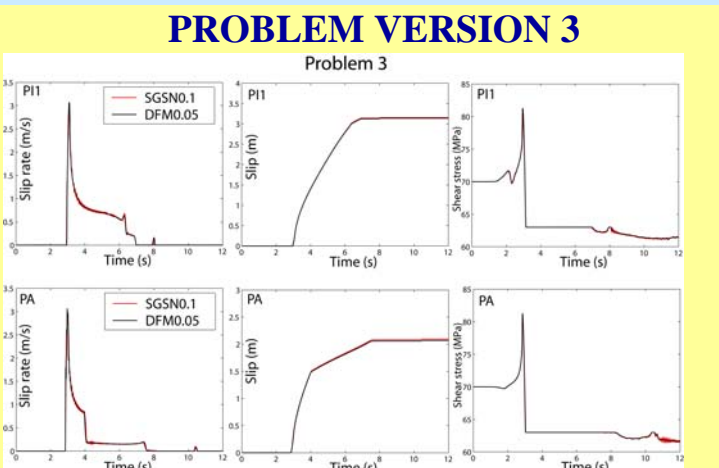


Figure 3. Time histories of slip rate, slip and shear stress of SGSN0.1 (red) and DFM0.05 (black) solutions, at point P11 and PA marked in Figure 1 of problem version 3.

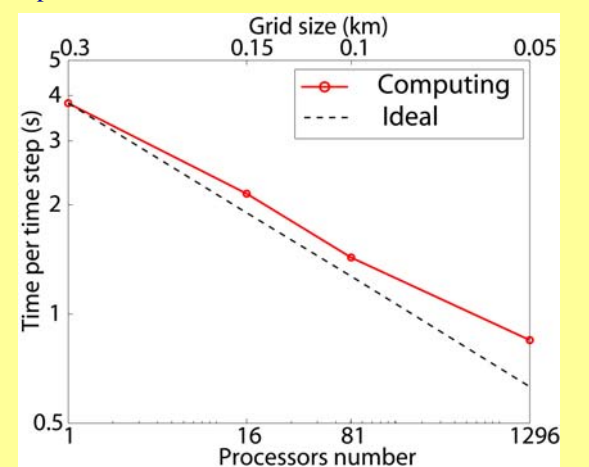


Figure 4. Scalability of the SGSN code using the Datastar cluster of the San Diego super computer Center (SDSC) of UCSD.

PROBLEM VERSION 3 (BIMATERIAL)

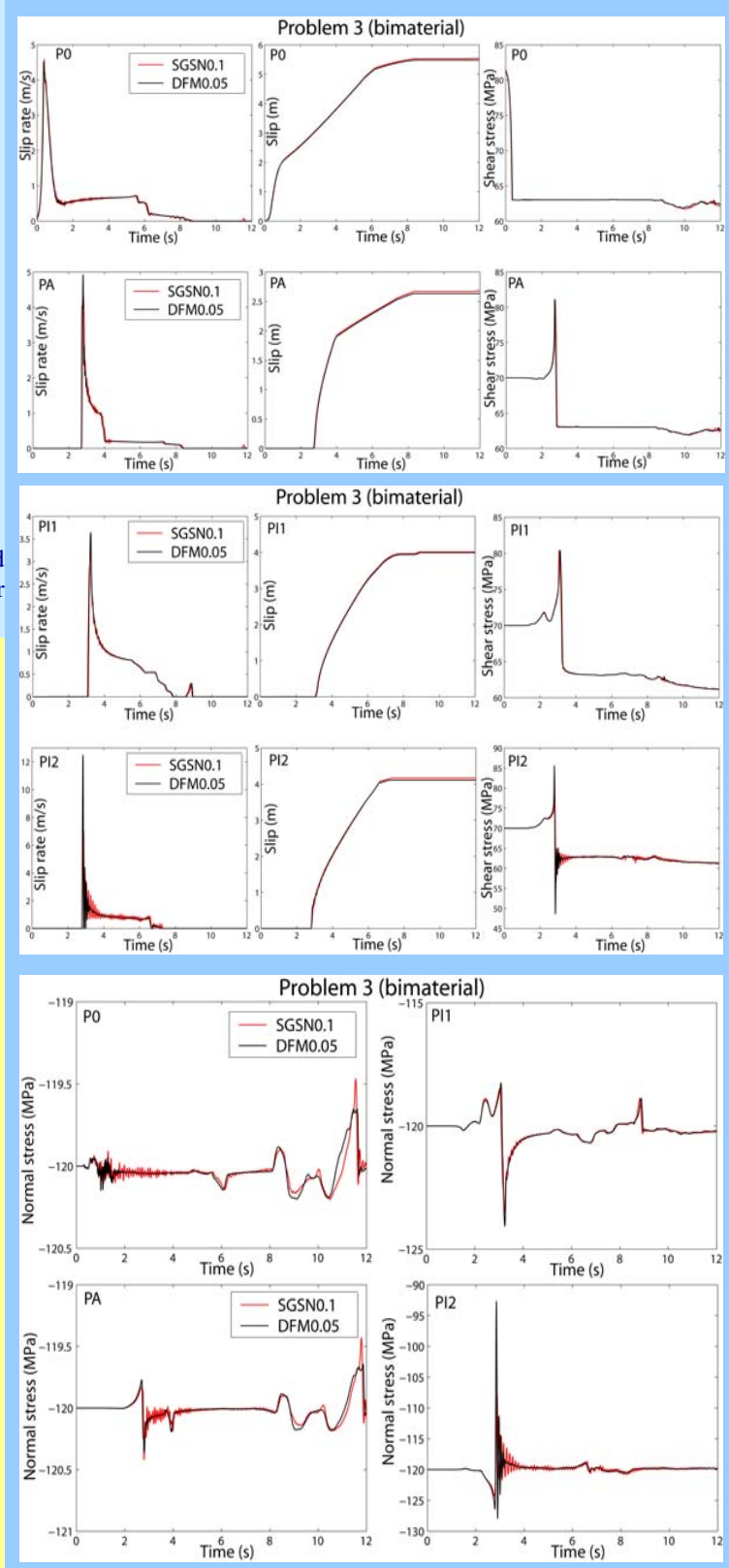


Figure 4. Time histories of slip rate, slip, shear stress and normal stress of SGSN0.1 (red) and DFM0.05 (black) solutions, at points P0, PA, P11 and P12 marked in Figure 1 of bimaterial-interface problem.

PROBLEM VERSION 5

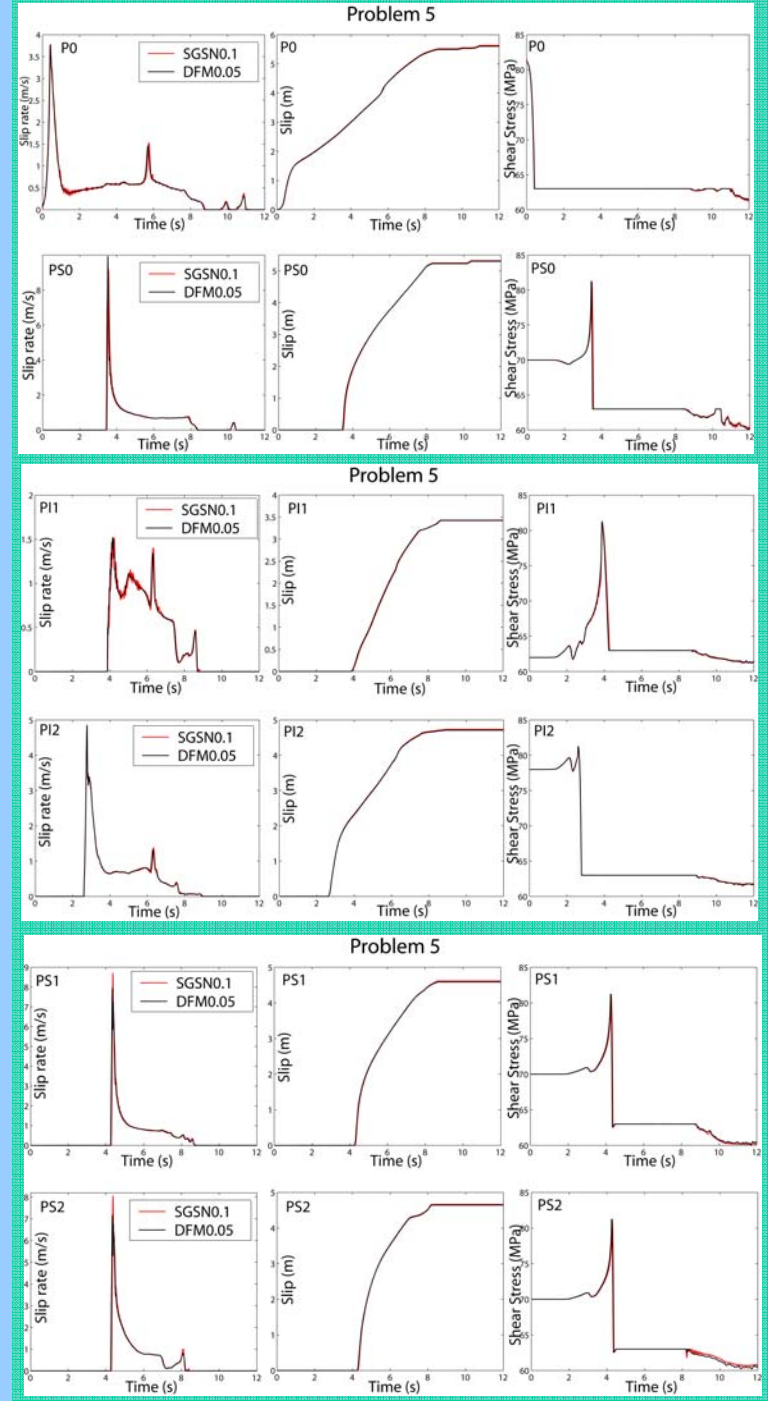


Figure 5. Time histories of slip rate, slip and shear stress of SGSN0.1 (red) and DFM0.05 (black) solutions, at points P0, PS0, P11, P12, PS1 and PS2 marked in Figure 1 of problem version 5.

REFERENCES:

- Dalguer, L. A., and S.M. Day (2006), *Staggered-Grid Split-Node Method for Spontaneous Rupture Simulation*. J. Geophys. Res., in review .
- Day, S. M., L.A. Dalguer, N. Lapusta, and Y. Liu (2005). *Comparison of finite difference and boundary integral solutions to three-dimensional spontaneous rupture*, J. Geophys. Res., 110, B12307, doi:10.1029/2005JB003813