Parallel Epic Porting, Simulations, and Performance

Manjit S. Sahota, Eric N. Harstad, and Paul J. Maudlin (T-3); Thomas A. Mason (MST-8); and Eric M. Mas (T-1)

We ported and investigated the parallel performance of a parallel version of the Epic code to Los Alamos National Laboratory (LANL) computers. This required extensive debugging of the existing code and numerous code modifications and model improvements especially related to the TEPLA model.

Figure 1 shows Epic simulations of a miniature-detonator experiment conducted at LANL (a tantalum cylinder driven by a cylinder of PETN high-explosive detonated at the center of the outside surface) using a single processor and 21 processors on SGI Origin 2000. The 21-processor calculation has much higher mesh resolution, but the two calculations show about the same results indicating that the lower-resolution single-processor calculation is fully converged.

The agreement between these calculations and the experimental data also was observed to be excellent. Because of the complex eroding slide line logic in Epic, the net Epic speedup (after accounting for higher mesh resolution and increased number of cycles) on 21 processors was observed to be only about a factor of 10. However, without the use of parallel computing, such a study would have been much more inconvenient because it would have taken about 12 days to complete the fine-mesh calculation on a single processor of SGI Origin 2000 (as compared to little over a day in parallel mode).

Epic parallel performance is much better than the foregoing example when there are no eroding slide lines in the problem. Figure 2 shows normalized Epic speedup with increasing number of processors for a shear-localization experiment. The speedup is almost linear with the increasing number of processing elements (PEs) before it saturates at an element/PE ratio of about 1000 when the computational load on each PE starts to become much smaller than the communication cost.

We are currently in the process of porting and assessing Epic's performance on the Linux clusters.

For more information, contact Manjit Sahota (sahota@lanl.gov).

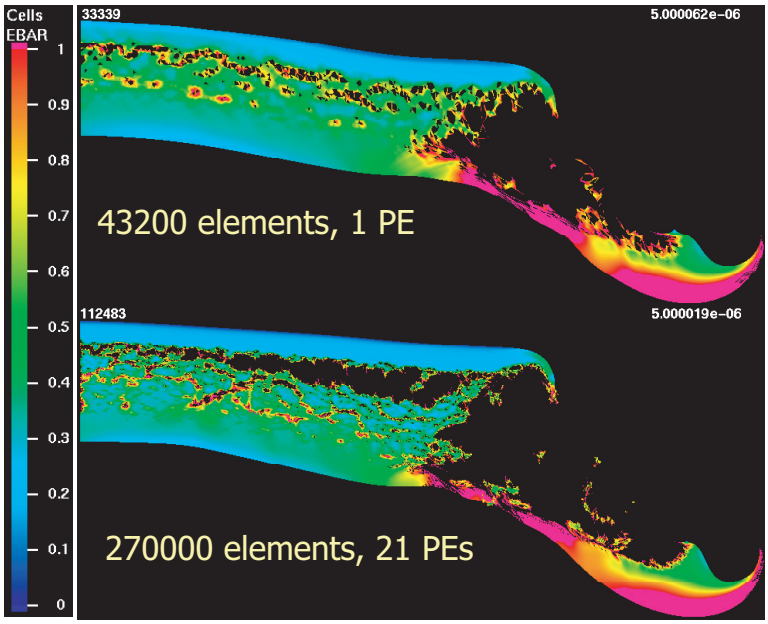

Figure 1—
Comparison of serial and parallel Epic calculations showing the color-coded contours of equivalent plastic strain for a miniature-detonator experiment.

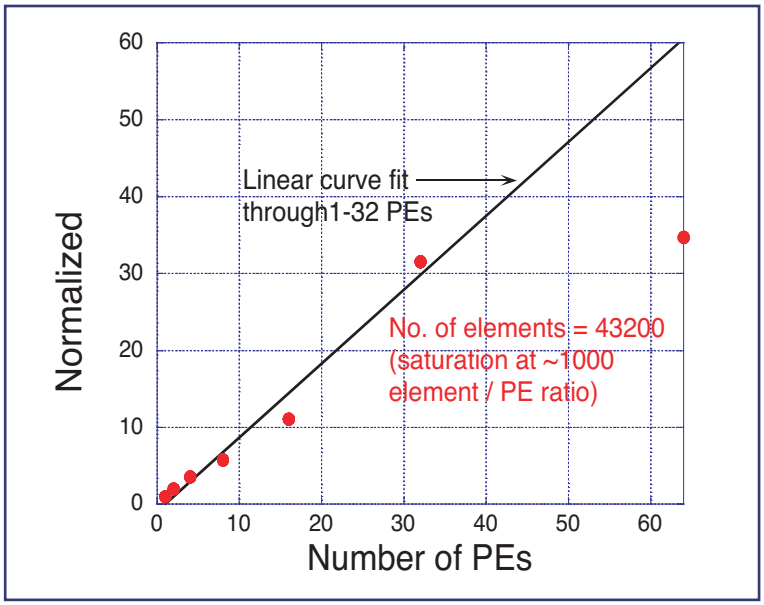

Figure 2—
Epic parallel performance on SGI Origin 2000 for shear-localization experiment. The calculation used 43,200 elements and required no eroding slide lines.

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