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Kalyan S Perumalla* (perumallaks@ornl.gov), PO Box 2008, MS-6085, ORNL, Oak Ridge, TN 37831-6085. *Discrete Event Execution and Reversibility: Challenges in the Path to Asynchrony for Massively Parallel Computing*. Preliminary report.

To keep up with the increasing number of processing elements in parallel/distributed computing, traditional tightly-coupled time-stepped models must give way to asynchronous models, such that the coupling among model components across processors is relaxed. Two challenges in defining mathematical models amenable to efficient asynchronous execution are: (1) the ability to define/determine discrete events of changes to component state over time with guaranteed bounds on stability and accuracy, despite the staggering of updates, and (2) the ability to take the model backward in time with minimal memory cost, in order to make corrections to local computations that may occur due to relaxation of global synchrony. We illustrate these considerations in some applications of interest, such as molecular dynamics and fluid dynamics, and allude to some ways in which applied mathematics research could impact asynchronous computing. (Received September 22, 2011)