ABSTRACT: Simulation of HPC applications has an important role in performance prediction, studying different interconnect topologies and development of new architectures. The goal of this project is to integrate traces of production MPI and Charm++ applications with the CODES\textsuperscript{2} network simulator in order to simulate production applications in addition to synthetic communication patterns. The CODES simulator provides network models for various topologies (such as torus and dragonfly) and is built on the scalable ROSS\textsuperscript{3} Parallel Discrete Event Simulator (PDES) framework.

**MOTIVATION:**

- **State of the art:** Current simulators are not scalable or do not simulate production applications
- Not scalable because they are not running in parallel, e.g. BigSim
- Only simulate synthetic hard-coded communication patterns, e.g. CODES
- **Goal:** Creating a scalable, parallel, packet-level network simulator for production HPC applications
  - Get the task dependencies from the applications via traces and simulate their behavior
  - Only simulate synthetic hard-coded communication patterns, e.g. CODES
  - Not scalable because they are not running in parallel, e.g. BigSim

**DESIGN:**

- **Trace Trains for one processor**
  - Time Stamp, Task ID, Name, Duration...

**Application Traces:**
- In BigSim trace file format
- Records every event throughout the application
- Generated via BigSim Emulator
- Capable of emulating multiple MPI ranks per process.

**Network Models:**
- Detailed models that CODES simulator provides
- Able to simulate 50 million nodes
- Built on ROSS Parallel Discrete Event Simulator

**Parallel Discrete Event Simulator**
- **ROSS:** A scalable framework for PDES
- Uses the Time Warp synchronization protocol
- Can process billions of events per second
- Has sequential, conservative and optimistic modes

**SUMMARY and FUTURE WORK:**

- Integrating production application simulation with CODES simulator
- Future work:
  - Add support for optimistic mode, current support is for conservative mode
  - Do a performance study of different simulators, CODES, BigSim, SST etc.

**References:**
1. BigSim, Simulating PetaFLOPS Supercomputers http://charm.cs.uiuc.edu/research/bigsim