

A Dataflow Overlay for Monte Carlo Multi-Asset Option Pricing on AMD Versal AI Engines

Mohamed Bouaziz¹, Michael Samet², Suhail A. Fahmy¹

¹ King Abdullah University of Science and Technology, Saudi Arabia

² RWTH Aachen University, Germany

Motivation

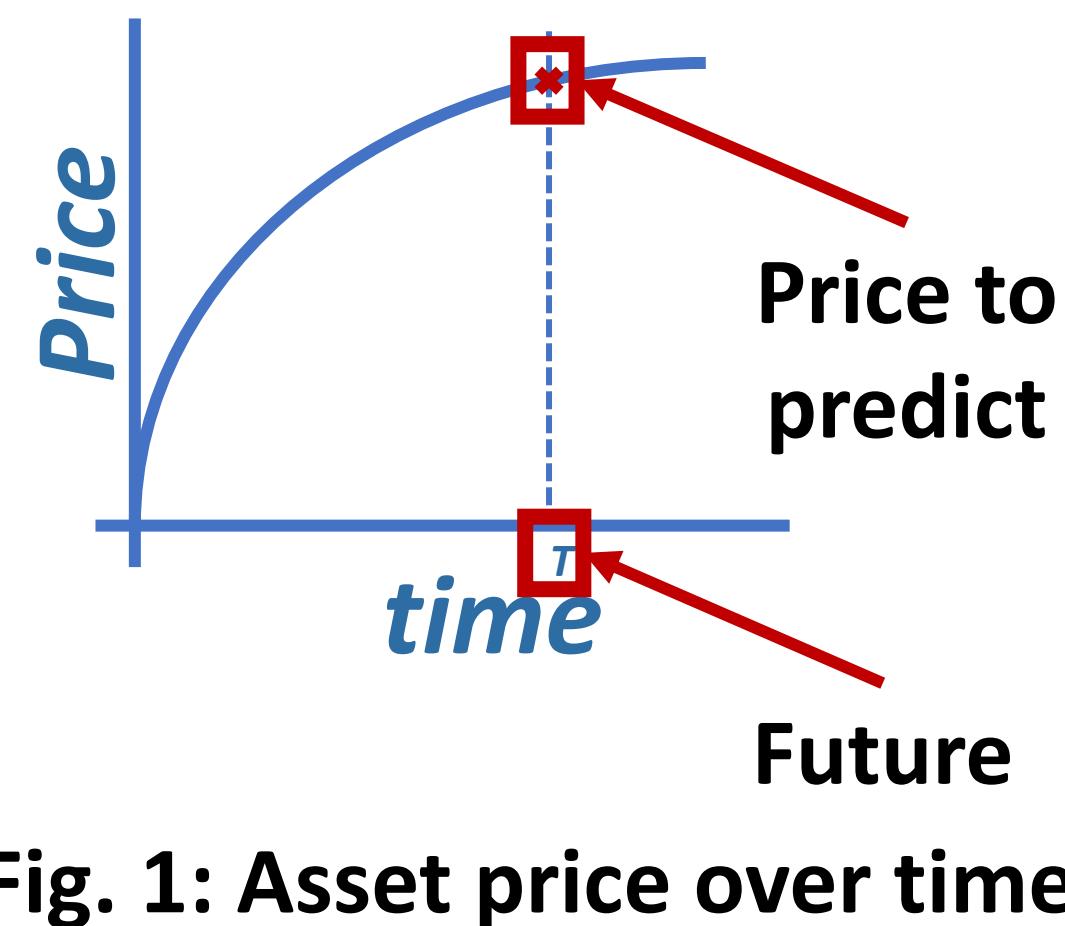


Fig. 1: Asset price over time.

Price evolution (GBM model) $S_i(T) = S_i(0) \exp \left(\left[r - \frac{1}{2} \sigma_i^2 \right] T + \sigma_i \sqrt{T} \sum_{1 \leq j \leq d} L_{i,j} Z_j \right)$

- Monte Carlo Simulation ✓
- Compute intensive ✗
- Need for a highly parallel dataflow design of the MC-based pricer

Overlay Design

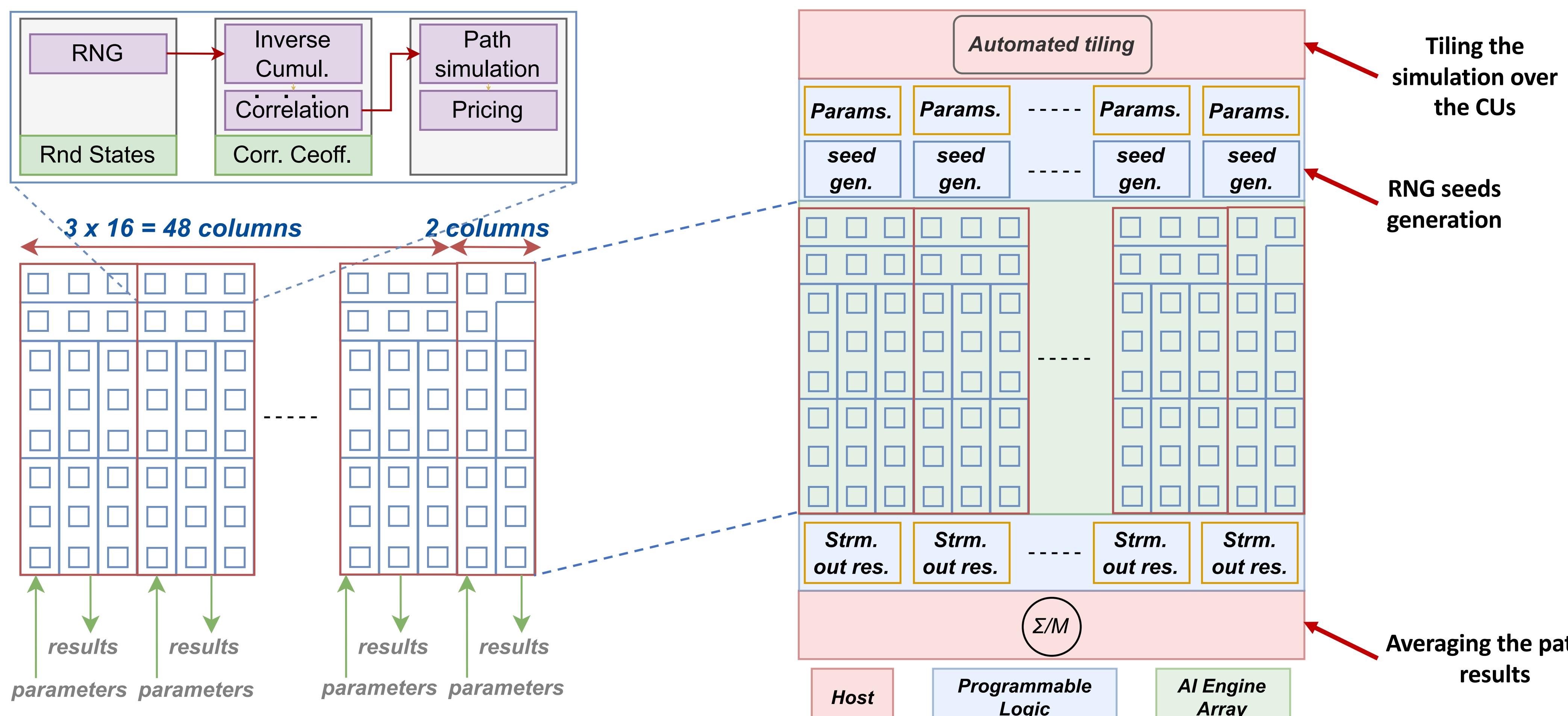


Fig. 5: Mapping of 133 CUs to AIE array.

Fig. 6: Tasks allocation on Versal SoC.

Proposed Approach

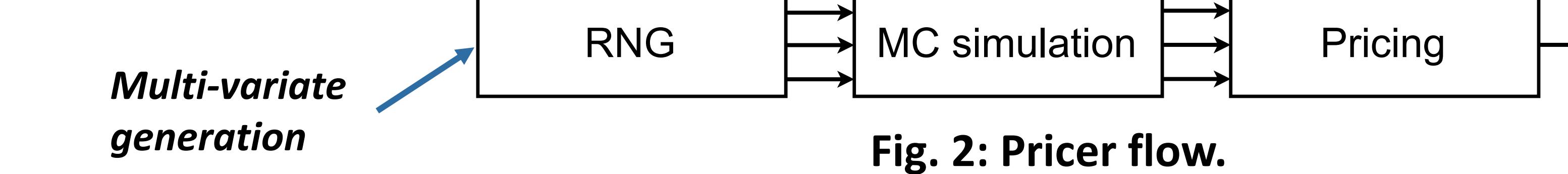


Fig. 2: Pricer flow.

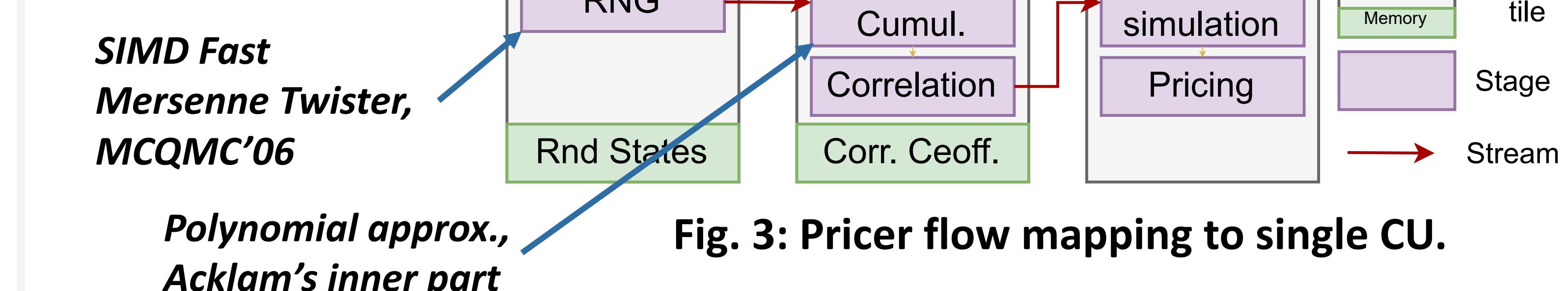


Fig. 3: Pricer flow mapping to single CU.

SIMD Fast Mersenne Twister, MCQMC'06

Polynomial approx., Acklam's inner part

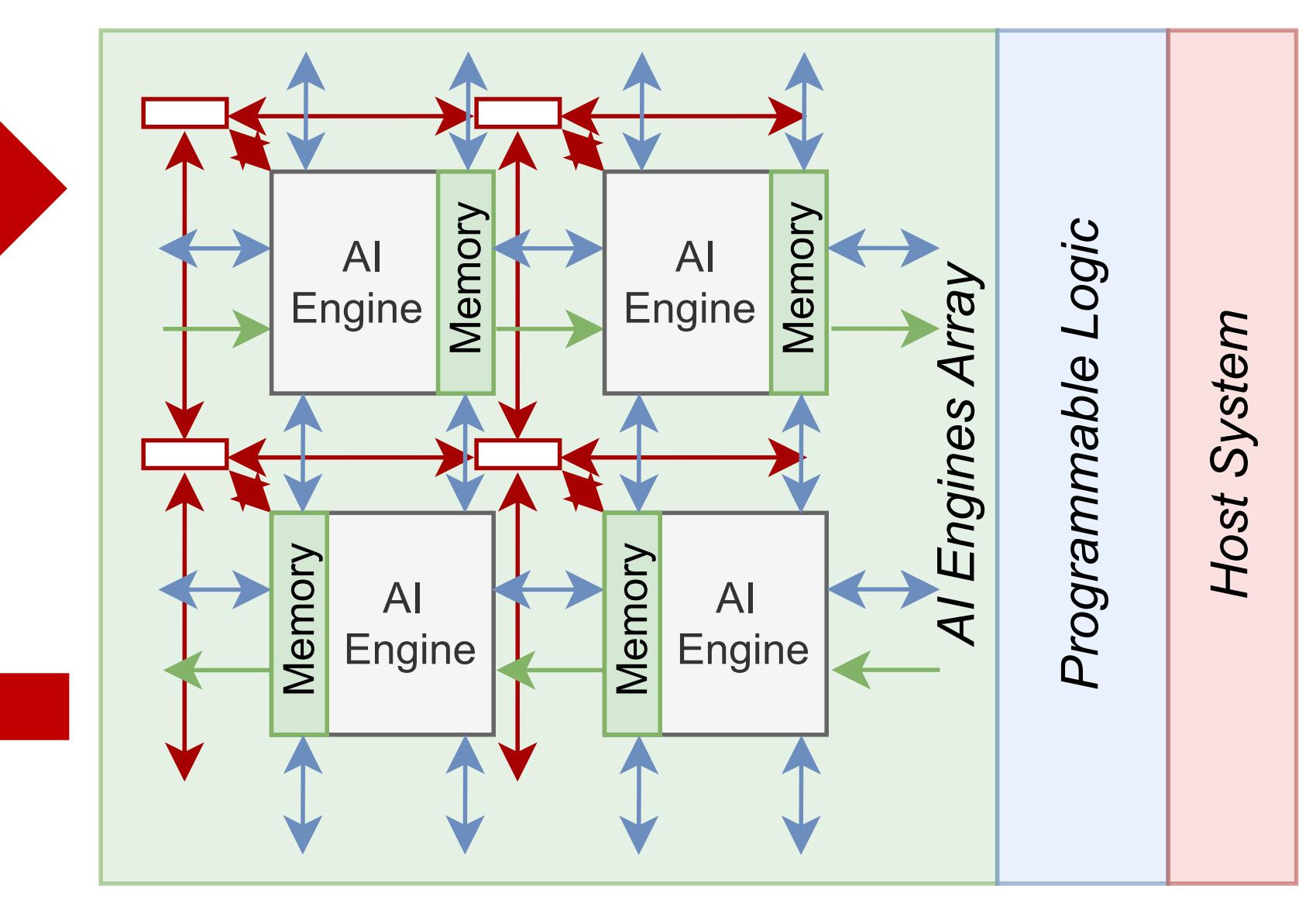


Fig. 4: AMD Versal SoC.

Experimental Results

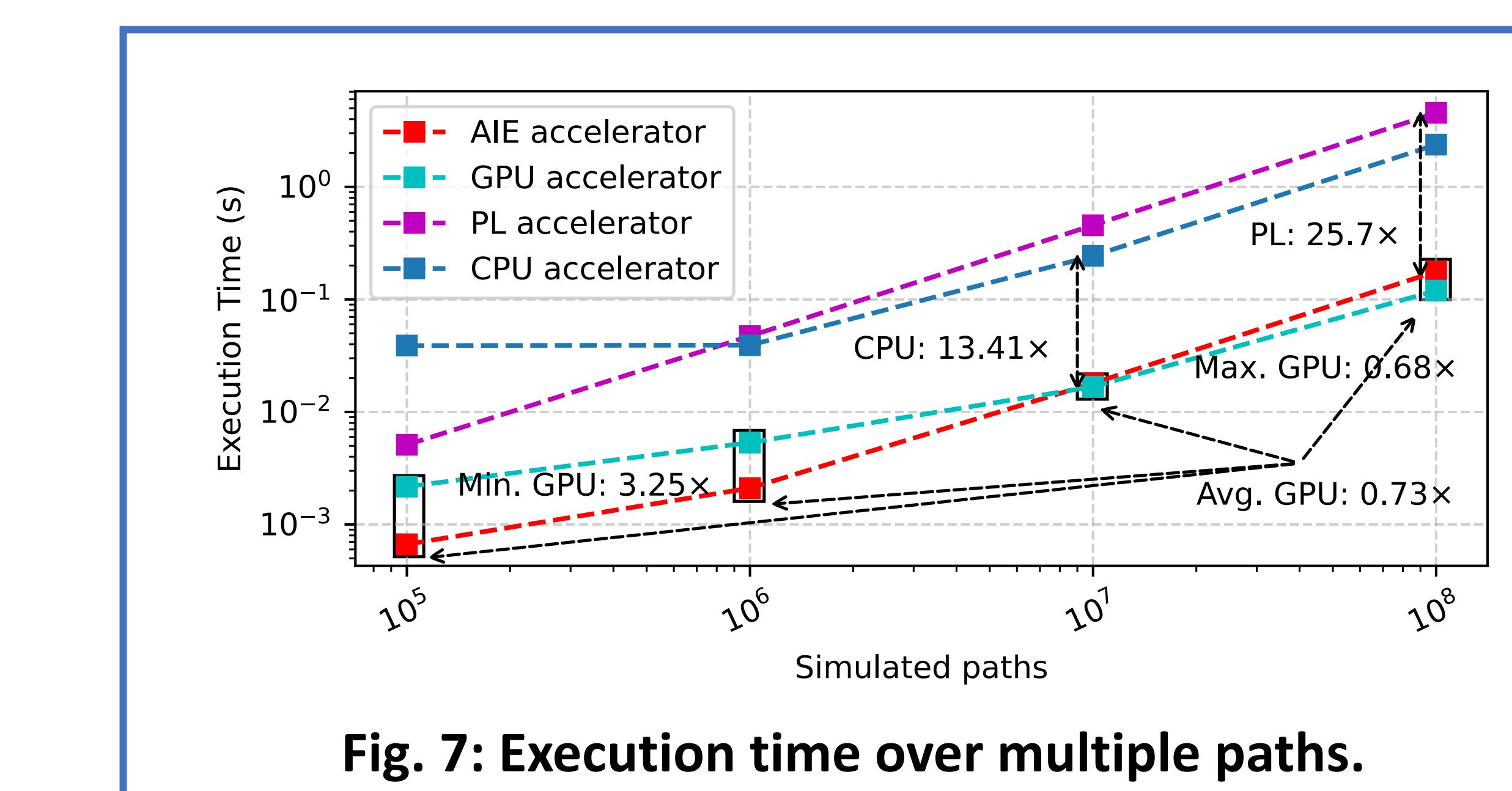


Fig. 7: Execution time over multiple paths.

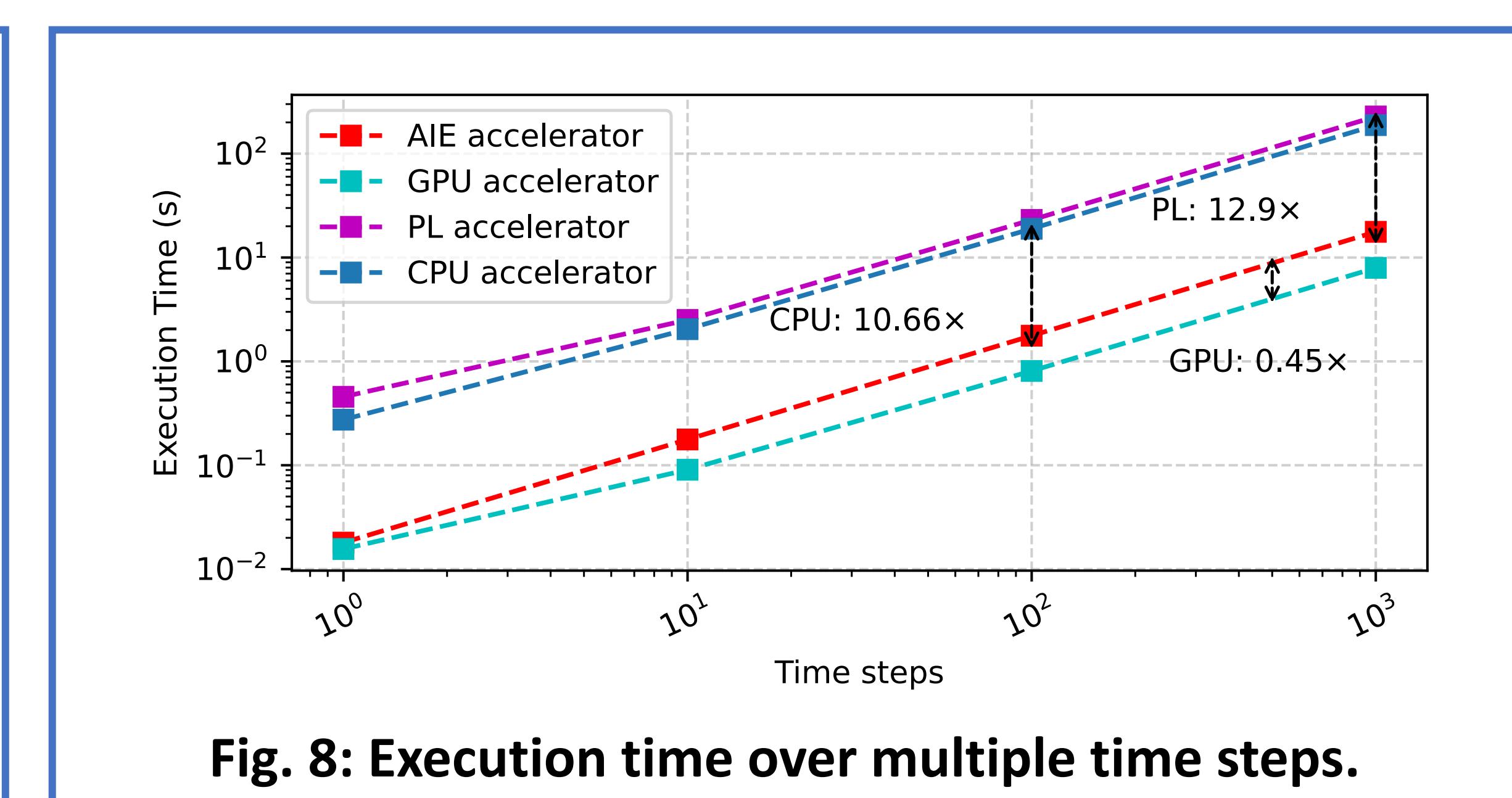


Fig. 8: Execution time over multiple time steps.

→ 25.7x faster than FPGA, 13.41x faster multi-threaded CPU, 0.73x as fast as GPU but 1.82x more energy efficient.