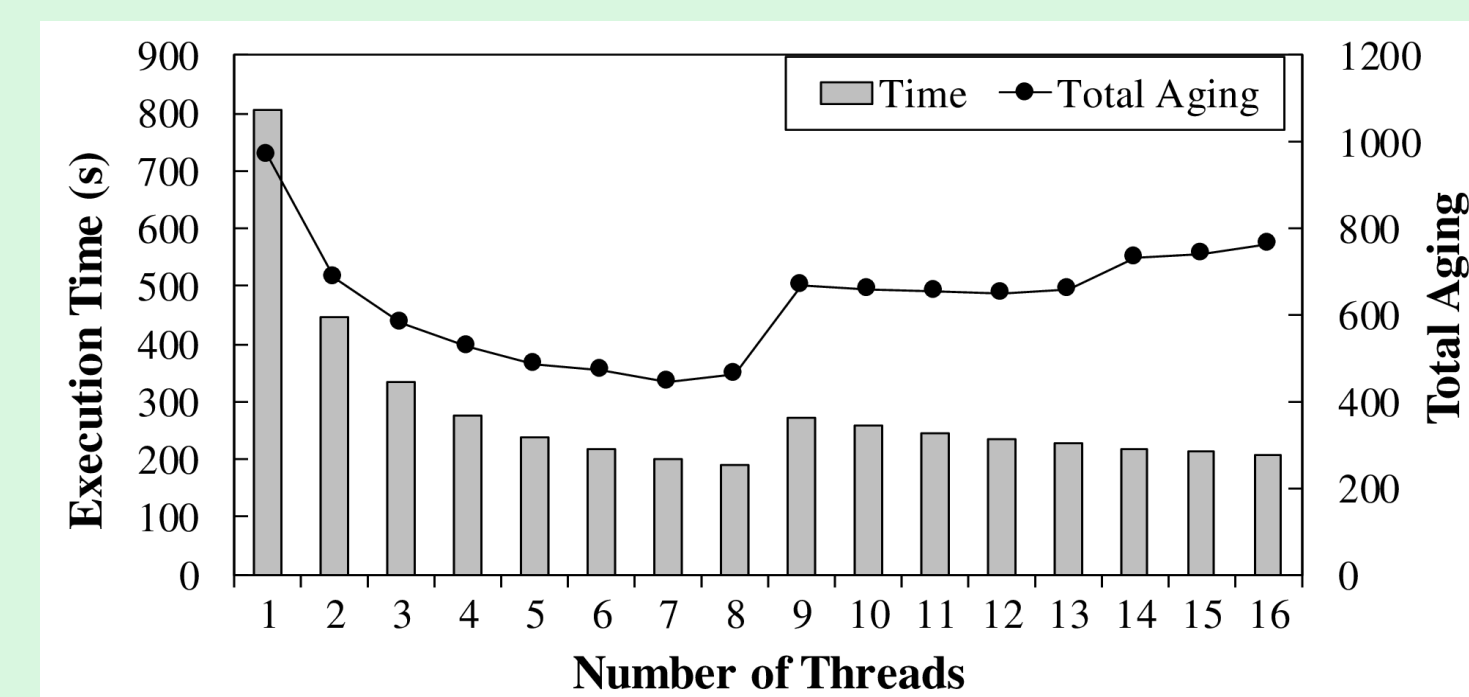
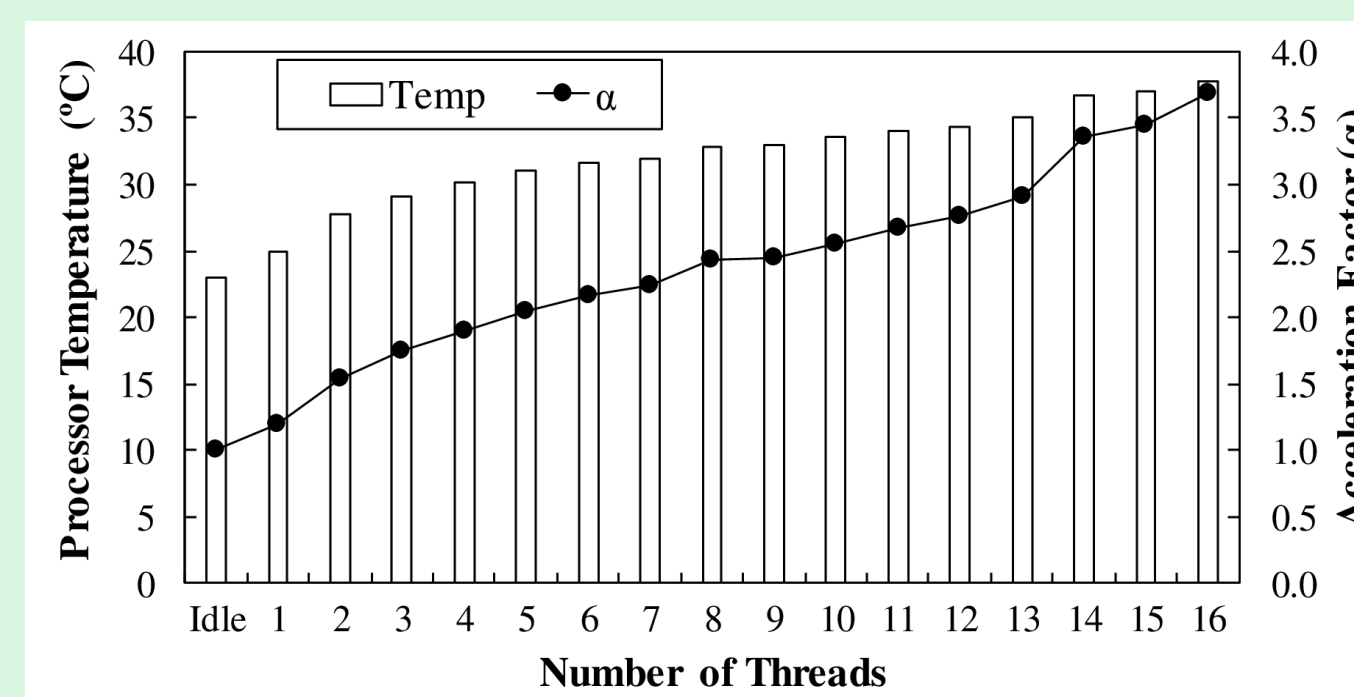
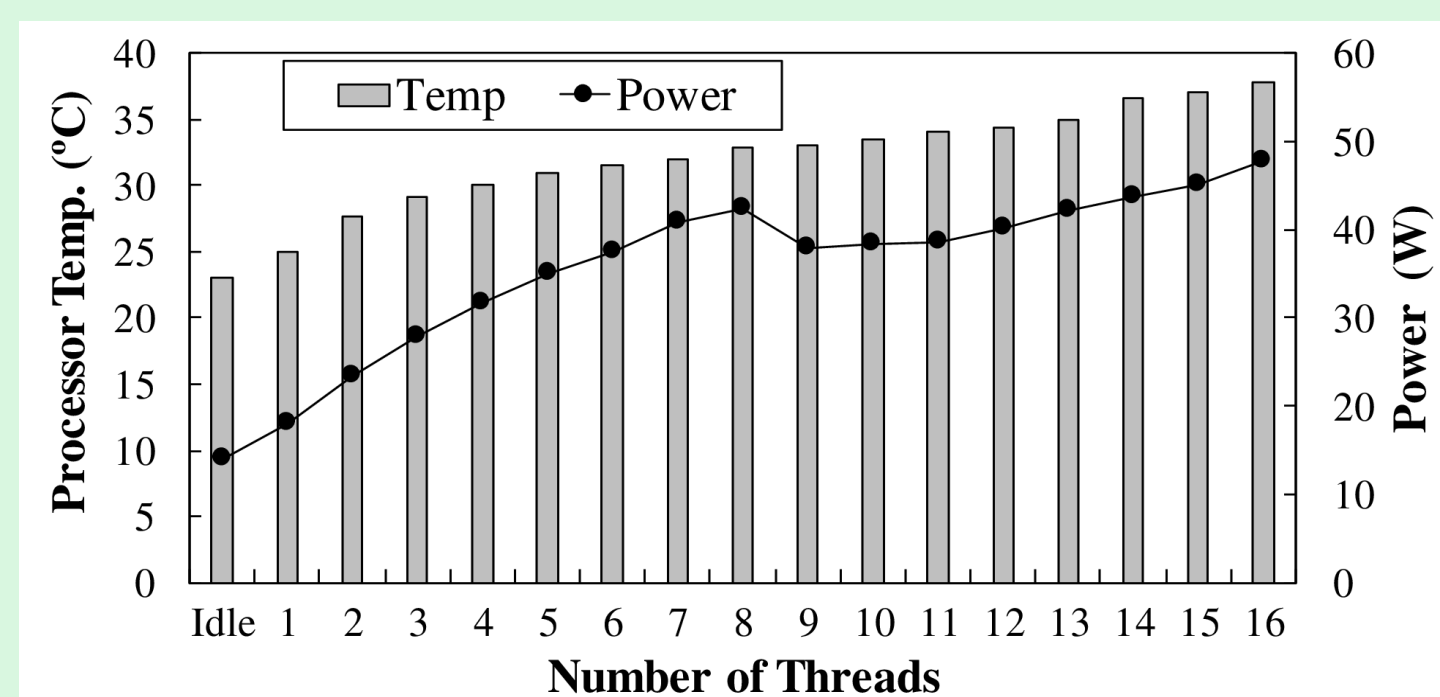




## Motivation

Behavior of BT kernel from the NAS Parallel Benchmark execution on an AMD-Ryzen 16-threads



The processor temperature rises as the number of threads increases.

Higher operating temperatures influence aging in hardware components.

Many applications do not scale as the number of threads increases.

By applying thread throttling, the processor aging can be optimize.

## Geras

### Background

- Find a balance between performance and power dissipation.
- It uses Arrhenius equation to calculate the aging acceleration factor.
- A Learning algorithm to find the ideal number of threads.
- It uses lateral movement for avoid plateaus and minimum local.
- Based on a hill climbing algorithm.

### Characteristics

- **Integrated with OpenMP** (incorporated into the libgomp).
- Works with any OpenMP application and is **completely transparent**.
- **No code modifications or recompilation**.
- **Optimize** each parallel region independently.

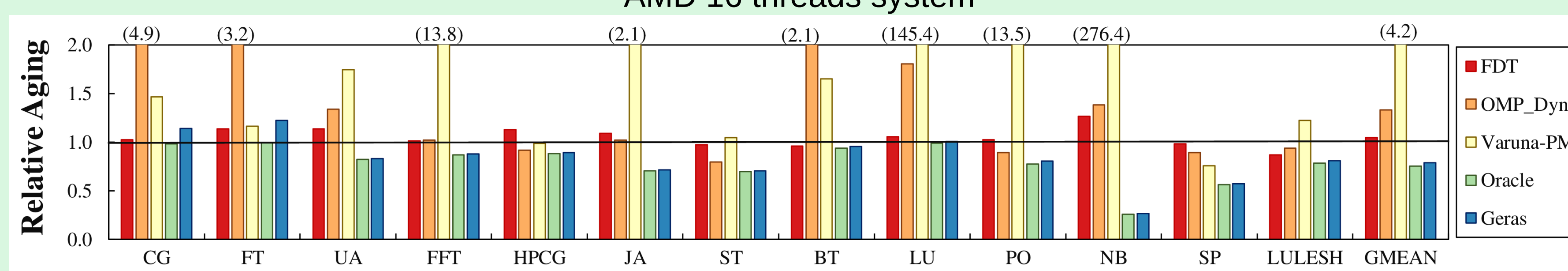
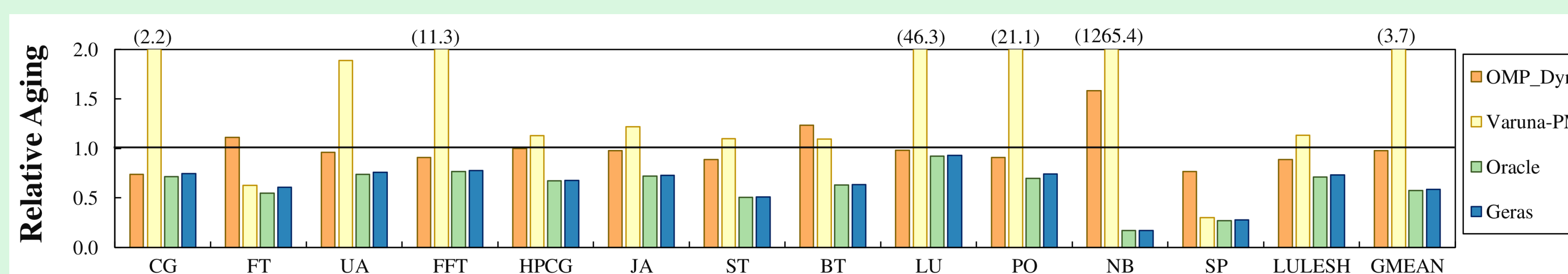
## Evaluation

### Methodology

- Two multicore plataforms (8-core/16-threads AMD and 2x6-core/24-threads Intel).
- Applications compiled with GCC/g++ 8.1, -O3 flag, and OpenMP 4.0.
- DVFS governors: *powersave* (AMD only), *ondemand*, and *performance*.
- Average of ten executions for each configuration (standard deviation < 0.5%).

### Compared Scenarios

- **Standard OpenMP**: maximum number of threads available in the system.
- **Oracle solution**: ideal number of threads.
- **OMP\_Dynamic**: a built-in feature of OpenMP that dynamically adjust the number of threads of each parallel region.
- **Varuna-PM**: create a pool of tasks to optimize the degree of parallelism.
- **FDT**: number of threads based on the contention for locks and memory bandwidth.



Processor aging normalized to STD (black line) considering the *performance* DVFS governor

### Conclusions

- In the overall, the processor aging when using Geras is:
  - > 35% lower than regular OpenMP execution
  - > 38% lower than OMP\_Dynamic
  - > 84% lower than Varuna-PM
  - > 25% lower than FDT
- Geras is, in most cases, only 0.01% distant from an Oracle solution.