READEX

Runtime Exploitation of Application Dynamism for Energy-efficient eXascale computing

European Commission

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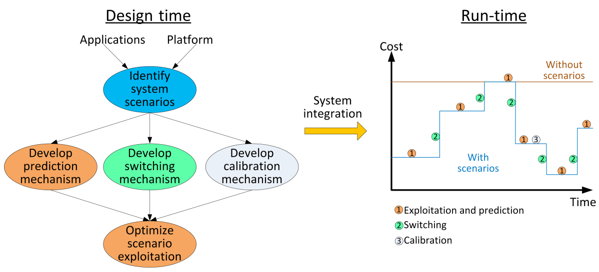
RUNTIME EXPLOITATION OF APPLICATION DYNAMISM FOR ENERGY-EFFICIENT EXASCALE COMPUTING

OVERVIEW

- Exploit dynamic behavior of HPC applications to achieve improved energy-efficiency and performance
- Develop a tools-aided scenario based dynamic auto-tuning methodology
- Bring together experts from embedded systems and HPC

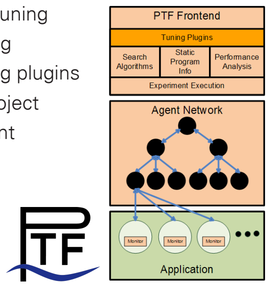
SYSTEM SCENARIO METHODOLOGY

- Split design-time / run-time dynamic application design approach from the embedded world
- **Design time**: scenario identification and tuning model creation
  1. Detect Run-time Situations (**RTS**) based on identifier (e.g., control variables)
  2. Cluster RTS with similar costs to form **scenarios**
  3. Find optimized platform configurations using **multi-objective tuning**
- **Run-time**: scenario prediction using identifiers followed by platform configuration switching
  - Input: tuning model created at design-time
  - Calibration step to react to unknown scenarios and refine tuning model



PERISCOPE TUNING FRAMEWORK

- Integrated process for static auto-tuning
- PATHWAY GUI for progress tracking
- Expert knowledge codified in tuning plugins
- Developed in the AutoTune FP7 project
- Based on the Score-P measurement infrastructure



URL: http://periscope.in.tum.de

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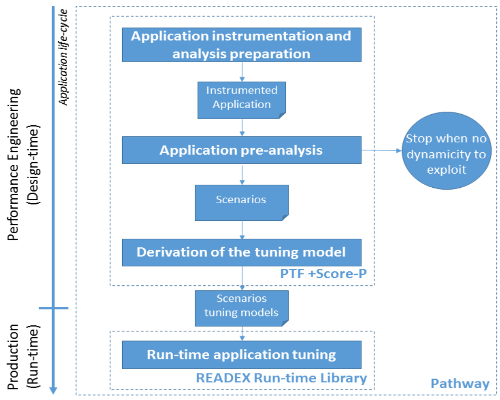
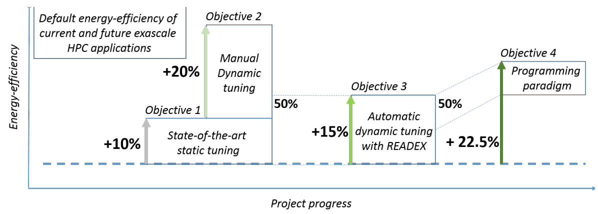
READEX TOOLS-AIDED METHODOLOGY

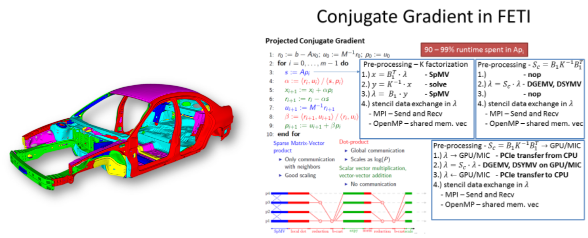
- Automatic design time analysis and exploitation at run-time
- Design time analysis based on PTF, Pathway, and Score-P
- Lightweight READEX Runtime Library (RRL) for scenario prediction and switching
- READEX Programming Paradigm: User-defined scenario identifier and application-level tuning parameter



EXPECTED IMPACT AND VALIDATION

- Real-world target applications PERMON and ESPRESO for engineering applications
- Indeed industry-grade FEM code
- Achieve up to 22.5% improvement in energy-efficiency
- Co-design approach with manual application tuning and result/effort comparison





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