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Design-time Analysis for the READEX Tool Suite

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Abstract. Energy efficiency and consumption are now the most important and challenging issues in current Petascale and in designing future Exascale computing systems. The European Union Horizon 2020 READEX project uses an online approach to exploit application dynamism and tune large-scale HPC applications to improve energy efficiency and performance. The paper presents the READEX methodology, consisting of the Design-Time Analysis and Runtime Application Tuning, and describes the pre-analysis steps involving application dynamism and significant region detection. During design-time, the READEX tuning plugin evaluates configurations of hardware and software tuning parameters to determine the best settings for instances of application regions. The runtime tuning dynamically switches to the best configuration for an application region during production runs. Finally, the energy savings obtained for LULESH on the Taurus supercomputer highlight the effectiveness of this methodology.

1. Introduction

High Performance Computing requires significant electrical energy, and energy efficiency remains a key challenge in today's HPC landscape. As developers typically lack the platform and hardware knowledge, and tools to influence the energy consumption, improvements to the energy efficiency of applications have been rarely targeted. To overcome this challenge, READEX aims to deliver the first standalone auto-tuning framework that dynamically tunes large-scale HPC applications at design- and runtime for Exascale computing.

READEX (Runtime Exploitation of Application Dynamism for Energy-efficient eXascale computing) is a European Union Horizon 2020 project and extends previous works that only statically tune the energy consumption by setting tuning parameters for the entire application run [1]. Instead, in READEX, the tuning parameter switching occurs dynamically during the application execution. READEX leverages dynamically varying application characteristics, such as compute intensity and algorithm granularity. READEX targets applications that exhibit iterative behavior, typically in the form of a main progress loop, called a *phase region*. Individual time steps of the loop are called *phases*. We extend an approach developed for tuning embedded systems, called *scenario based tuning* to the HPC environment. Here, *runtime situations*, which are executions of