

Teknisk- naturvetenskaplig fakultet UTH-enheten

Besöksadress: Ångströmlaboratoriet Lägerhyddsvägen 1 Hus 4, Plan 0

Postadress: Box 536 751 21 Uppsala

Telefon: 018 – 471 30 03

Telefax: 018 – 471 30 00

Hemsida: http://www.teknat.uu.se/student

Abstract

Performance optimization of the online data processing software of a high-energy physics experiment

Péter Kardos

☐ The LHCb experiment probes the differences between matter and anti-matter by examining particle collisions. Like any modern high energy physics experiment, LHCb relies on a complex hardware and software infrastructure to collect and analyze the data generated from particle collisions. To filter out unimportant data before writing
it to permanent storage, particle collision events have to be processed in real-time
which requires a lot of computing power.
☐ This thesis focuses on performance optimizations of several parts of the real-time
data processing software: i) one of the particle path reconstruction steps; ii) the
particle path refining step; iii) the data structures used by the real-time reconstruction
algorithms. The thesis investigates and employs techniques such as vectorization,
cache-friendly memory structures, microarchitecture analysis, and memory allocation optimizations. \Box
☐The resulting performance-optimized code uses today's many-core, data-parallel,
superscalar processors to their full potential in order to meet the performance
demands of the experiment. The thesis results show that the reconstruction step got
3 times faster, the refinement step got 2 times faster and the changes to the data
model allowed vectorization of most reconstruction algorithms.

Handledare: Sebastien Ponce Ämnesgranskare: Anca-Juliana Stoica Examinator: Jarmo Rantakokko IT 20 009 Tryckt av: Reprocentralen ITC