GEANT-4 GPU Port:

Software Requirements Specification
Volere Template, Edition 16

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Contents

1 Project Drivers

1.1 Purpose of Project

Project Background
Currently running GEANT4 simulations that require many particle takes a long time to compute when run on the CPU. By running the simulation on the GPU the user should be able to see a significant speed up in computation times

Goal of the project
The goal of this project is to port the GEANT4 code to be able to run on the GPU.

1.2 Stakeholders

2 Project Constraints

2.1 Mandated Constraints

2.2 Naming Conventions & Terminology

Throughout the document, "the project", "the product", and/or "the software" all refer to the modified GEANT-4 code that will run on a GPU. The "existing software" refers to the current GEANT-4 simulation program, including the modifications made by McMaster's Engineering Physics department to suit it to their needs.

Refer to the following table for definitions of all domain-specific terms used.

2.3 Relevant Facts and Assumptions

Facts

- GEANT4 is programed using C++

Assumptions

Term	Description
GEANT-4	open-source software toolkit used by stakeholders to simulate the passage of particles through matter
GPU	graphics processing unit, well-suited to parallel computing tasks
CUDA	parallel computing architecture for general purpose programming, developed by NVIDIA

Table 1: Glossary

- It is assumed that the user will have an understanding of particle physics
- It is assumed that the user will know how to use GEANT4

3 Functional Requirements

3.1 The Scope of the Work

3.2 Business Data Model & Data Dictionary

3.3 The Scope of the Product

The following table outlines the use cases for the product. Click the PUC # to go to its description.

PUC #	PUC Name	Actor(s)	Input/Output
1	Simulating Particles	Researcher	Simulation parameters (in), Distribution of particle's locations (out)

Table 2: Product Use Cases Summary

Descriptions of each PUC, referenced by PUC # are as follows.

1. The software will be used by researchers wishing to simulate large numbers of particles interactions with materials. The researcher sets simulation parameters, including the number of particles, their lifetime,

and the material properties before running the simulation. On completion, the program gives back a map of where each particle travelled, so researchers can study where the particles are most probably to end up.

3.4 Functional Requirements

Placeholder

4 Non-functional Requirements

4.1 Look and Feel Requirements

4.2 Usability and Humanity Requirements

4.3 Performance Requirements

Requirement #: 4.3

Description: Decreasing the time it takes to run a simulation while maintaining identical results

Fit Criterion: Running a simulation with a given set of input parameters should complete significantly faster on the product as compared to the existing software. Both should have identical outputs.

Dependencies: None

History: Created September 27, 2015

4.4 Operational and Environmental Requirements

Expected Physical Environment

- The product shall be used by an engineering Physics professor, researcher or student
- The user will be sitting down in a temperature controlled environment

Requirements for interfacing with adjacent Systems

- The product shall work with the last four versions of GEANT4

Productization Requirements

- The product shall be distributed as a ZIP file.
- The product will be available on a public repo for users to download

Release Requirements

- Later versions of the product that have been patch will be available on the public repo
- Each release shall to cause previous features to fail.

4.5 Maintainibility and Support Requirements

4.6 Security Requirements

4.7 Cultural Requirements

4.8 Legal Requirements

Compliance Requirements
N/A
Standards Requirements
N/A

5 Project Issues

5.1 Open Issues

5.2 Off-the-Shelf Solutions

5.3 New Problems

5.4 Tasks

Record of Proposed Project	September 18
Problem Statement	September 25

Requirements Document Revision 0	October 9
Proof of Concept Plan	October 23
Test Plan Revision 0	October 30
Proof of Concept Demonstration	November 16 - 27
Design Document Revision 0	January 1
Revision 0 Demonstration	February 1 - 27
User's Guide Revision 0	February 29
Test Report Revision 0	March 21
Final Demonstration (Revision 1)	Exam period
Final Documentation (Revision 1)	April 1

5.5 Migration to the New Product

5.6 Risks

5.7 Costs

5.8 User Documentation and Training

- Function descriptions shall be provided for every new function.
- There shall be .txt file accompanying the project that will explain to the user the changes as well as how to use the new functions
- Users who know how to use GEANT4 should be able to easily use the new functions

5.9 Waiting Room

5.10 Ideas for Solutions