Software Requirements Specification

CS 258 Software Engineering

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Modelling of Debris Flow Simulation

Software Requirements Specification

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# Revision History

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# Document Approval

The following Software Requirements Specification has been accepted and approved by the following:

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# 1. Introduction

## 1.1 Purpose

The purpose of this document is the detailed presentation of a Debris Flow Simulation. The document explains the purpose and features of the system, what it will do and the constraints under which it must operate.

## 1.2 Scope

The software produces a landslide simulation. This software helps to analyze the effect of a landslide over a particular area given suitable inputs. The system actually takes the input map of the region, initial landslide thickness map, soil density as input and present the simulation of the landslide as the output thus predicting and analyzing the effect of the landslide.

## 1.3 Definitions, Acronyms, and Abbreviations

**DEM(Digital Elevation Map)**- The surface elevation map is a common digital elevation model (DEM), from which the initial landslide body has been already subtracted. This map defines not only the basal topography for the flow, but also the computation domain, so any missing value pixels in this map will be kept out of the calculations.

**Landslide Thickness Map** - The landslide initial thickness map is measured in the direction normal to the surface, and not in the Cartesian vertical direction; it can be obtained as h = h\_vertical \* cos(alpha), alpha being the slope gradient.

**Fluid Distance Map** - The fluidization distance map indicates the distance to the toe of the landslide. The toe of the landslide, which is defined as having zero distance, is considered to be fluid at the beginning of the simulation. From that area, fluidization advances at a time rate defined by the fluid\_rate parameter.

**Rheology** – Rheology is the study of the flow of matter, primarily in a liquid state, but also as "soft solids" or solids under conditions in which they respond with plastic flow rather than deforming elastically in response to an applied force.

**Outlet Map**-The outlet map is usually just a map of (boolean) zeros, in which case the boundaries of the spatial domain are considered closed (the flow can not escape from the spatial domain). In some cases, though, it is convenient to allow the flow to escape from the computation domain, for example if there is a river at the bottom of the hill slope which is able to remove all the material that enters the stream. In this case, an open boundary can be indicated as a line of (boolean) ones in the outlet map.

## 1.4 References

[1] IEEE. IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications. IEEE Computer Society, 1998.

[2] Beguería, S., Van Asch, T.W.J., Malet, J.P. & Gröndahl S. (2009): A GIS based numerical model for simulating the kinematics of mud and debris flows over complex terrain', Natural Hazards and Earth System Sciences 9, 1897-1909.

## [3] Beguería S. (2009) massmov2d: A numerical model for mass movements over complex topography, doi:10.5281/zenodo.930061.

## 1.5 Overview

# The following section includes the overview of the functionality of the software. It describes the requirements for the completion of the software. The section following to that includes a much technical orientation dealing with technical aspect of the functionalities of the software.

# 2. General Description

## Debris flows is a major national and worldwide hazard causing destruction of lives, property and infrastructures. The occurrence of debris flows is probably going to increase in the near future due to high intensity erratic rainfall because of the imminent climate change. The debris flow is frequently considered to be a blend of viscous slurry, comprising of finer grain sizes and water, and coarse particles. The volume and the arrangement of the blend are the principal factors that add to decide the perils related with such phenomena, since they oversee the versatility and effect vitality of the debris. The research involves about modelling the run out and debris height of a channelised debris flow for a specific region. This would evaluate the possible ranges of the areas affected by the run out and to characterise the ranges of the input parameters and to assess the probability of the output. The development, implementation and application of the debris-flow entrainment model using field study would emphasize the importance of entrainment for runout modeling. The events would be selected based on its impact and severity in the region for calibration applying various rheologies.

## 2.1 Product Perspective

## The model has been implemented as a PCRaster script. PCRaster is a free GIS package and dynamic modeling system, and provides standard tools for editing the input maps and visualizing the results through map animations, time series, etc.

## 2.2 Product Functions

The model takes DEM, initial Landslide Thickness Map, Fluid distance map as input from the user. It further processes the value and build the landslide simulation over the area based on the input.

## 2.3 User Characteristics

The user should know: -

1. The usage of input maps and its attributes.
2. Various rheology involved in debris flow.

## 2.4 General Constraints

1. Knowledge about Debris Flow.

2. Analyzing for different types of rheology

## 2.5 Assumptions and Dependencies

Assumptions:

1. Python 3.6 or 2.7 available
2. Pcaster installed on the compute

Dependencies:

1. Pcraster
2. Python 2.7 or 3.6

# 3. Specific Requirements

## 3.1 External Interface Requirements

### 3.1.1 User Interfaces

Windows/Linux

### 3.1.2 Hardware Interfaces

PC/Laptop

### 3.1.3 Software Interfaces

1. Sublime Text

2. Command Prompt/ Terminal

3. Pcraster

### 3.1.4 Communications Interfaces

None

## 3.2 Functional Requirements

The software project runs on Pcraster script. The functionality is discussed below.

The sacling of all the maps should be same.

### 3.2.1 Simulation

3.2.1.1 Introduction

The software simulates the landslide in a particular region based on the map

Of the region and initial condition provided.

3.2.1.2 Inputs

A number of input files are provided to massmov2d. Surface elevation (m): A scalar map, Landslide initial thickness: measured normal to the surface (m), outlet.map: A scalar map, Open boundaries of the computation domain (if any). A boolean map: fluid map Distance to the toe of the landslide (m): A scalar map.

3.2.1.3 Processing

The software solves the differential equation based on initial conditions

Provided

3.2.1.4 Outputs

The model produces a series of standard outputs, and many others can be produced by uncommenting the appropriate lines of code in the script. Reporting is done for each second of the simulation time.

3.2.1.5 Error Handling

To be found.

## 3.3 Non-Functional Requirements

### 3.4.1 Performance

### will be found

### 3.4.2 Reliability

### will be found

### 3.4.3 Availability

### pcraster should be available for script running.

### 3.4.4 Security

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### 3.4.5 Maintainability

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### 3.4.6 Portability

Able to run on any system supporting pcraster.

## 3.4 Inverse Requirements

None till now

## 3.5 Design Constraints

None till now

## 3.6 Logical Database Requirements

A database of the input map files shall be maintained in case of necessity.