Abstract

This document is the Software User Manual for OpenACCEL which is developed by team OpenACCELL and will be used by all Bachelor College students to help them get an understanding of mathematical modeling. OpenACCEL is a web-based application which is part of the Software Engineering Project (2IP35) at Eindhoven University of Technology.

This document complies with the Software Requirements Document (SRD) from the Software Engineering Standard, as specified by the European Space Agency (ESA) [? ].
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Chapter 1

Introduction

1.1 Intended readership
This document is intended for all end-users of the OpenACCEL, which are students and teachers at the Eindhoven University of Technology (TU/e).

1.2 Applicability
This document applies to the ACCEL website.

1.3 Purpose
The purpose of OpenACCEL is, as stated in the URD, to aid students in understanding and building mathematical models.

1.4 How to use this document
First-time users are encouraged to read chapter 4 which will give a basic understanding about OpenACCEL. Also users are encouraged to attend the new Introduction to Modeling courses which will be all about getting an understanding of modeling and the usage of OpenACCEL.

1.5 Related documents
The URD for the OpenACCEL project.

1.6 Conventions
No conventions are made.
1.7 Problem responding

Since the OpenACCEL group will be dissolved after completion of the ACCEL project, the issue of problem reporting is left to C.W.A.M. van Overveld, which will be the responsible lecturer of the Introduction to Modeling course.
Chapter 2

Overview

OpenACCEL is an application designed and developed by the OpenACCEL group for the Bachelor College subject Introduction to Modeling by C.W.A.M. van Overveld at the Eindhoven University of Technology. The purpose of this web-based application is to aid students in getting an understanding about modeling with their second educational mathematical knowledge.
Chapter 3

Tutorial

This chapter contains tutorials for performing actions and operations supported by OpenACCEL. All tutorials start from the homepage of OpenACCEL www.keesvanoverveld.com/Accel/accel.htm. The tutorials are based on the use cases described in the User Requirements Document (URD).

All tutorials will start with opening a webbrowser, preferably Chrome or FireFox, referencing to the homepage of OpenACCEL www.keesvanoverveld.com/Accel/accel.htm which looks like:

![Homepage of OpenACCEL](image)

To this end there could occur likely errors already, for instance the webbrowser is not supported or the server is offline.

3.1 Add definition

3.1.1 Functional Description

This tutorial is about adding a definition to a script. In order to do this the outcome of the polynomial $y = x^2$ will be simulated for a value of $x$, where $x$ will be an integer.
3.1.2 Cautions and Warnings

- When adding a quantity that already exists, it’s current definition will be overwritten. See tutorial 3.2 ‘Edit definition’.
- If the script is currently executing, it will be stopped.

3.1.3 Procedures

As stated the tutorial will start at the homepage of OpenACCEL (www.keesvanoverveld.com/Accel/accel.htm). To add a definition to an OpenACCEL script click the “Edit/Run script” tab. Now the following screen will show up:

![Figure 3.2: View of “Edit/Run script” tab of OpenACCEL](image)

At this moment it is possible to enter a definition into the script line input field. Add the following (new) definition into the field: ‘y = pow(x, 2)’. As a result OpenACCEL list down the dependencies which still have to be defined. In this case x still have to be defined.

![Figure 3.3: Definition ‘y = pow(x,2)’ is added to the script](image)

Next x will be defined since it still have to be done, let x = 3. Hence, add the following definition to the script ‘x = 3’ and the following screen will be shown:
Figure 3.4: Definition ‘x = 3’ is added to the script

As a result the output value of $y$ correspond to the function $y = x^2$.

3.1.4 Likely Errors

- Unsupported webbrowser
- Server offline
- Input error, misuse of functions

3.2 Edit definition

3.2.1 Functional Description

This tutorial is about editing a definition to a script. In order to do this the outcome of the polynomial $y = x^2$ will be simulated over a vector $x = [-3, -2, -1, 0, 1, 2, 3]$. Therefore the script of tutorial 3.1 will be edited.

3.2.2 Cautions and Warnings

- The current definition of the quantity being edited will be overwritten.
- If the script is currently executing, it will be stopped.

When adding a quantity that already exists, it’s current definition will be overwritten. If the script is currently executing it will be stopped.

3.2.3 Procedures

As stated the tutorial will start where tutorial 3.1 ends, hence the following screen is the start screen of this tutorial:
Figure 3.5: Representation of $y = x^2$ with $x = 3$

From here the script will be edited. Instead of having an output value of $y$ over one (1) value of $x$ a vector will be used as input, so $x = [-3, -2, -1, 0, 1, 2, 3]$. In order to edit a definition, click on the $x = 3$ definition (1). Next edit the definition from the input field (2).

Figure 3.6: Steps described to edit a script

Next edit $x$ and let $x$ be a vector $[-3, -2, -1, 0, 1, 2, 3]$. Hence, ‘$x = [-3, -2, -1, 0, 1, 2, 3]$’ and the following screen will be shown:

Figure 3.7: Definition ‘$x = [-3, -2, -1, 0, 1, 2, 3]$’ is added to the script

As a result the output values of ‘$y$’ correspond to the function $y = x^2$ over a domain of $[-3, 3]$.
3.2.4 Likely Errors

- Unsupported webbrowser
- Server offline
- Input error, misuse of functions (syntax errors)

3.3 Manipulating input values

3.3.1 Functional Description

This tutorial is about manipulative input values, e.g. sliders. As in the first tutorial the polynomial \( y = x^2 \) will be simulated over a domain of \([-5,5]\), where ‘x’ will be an integer. Instead of using input ‘x’ as a vector it is used as a slider input.

3.3.2 Cautions and Warnings

None.

3.3.3 Procedures

As stated the tutorial will start at the homepage of OpenACCEL (www.keesvanoverveld.com/Accel/accel.htm). To add a definition to a OpenACCEL script click the “Edit/Run script” tab. Now the following screen will show up:

![Figure 3.8: View of “Edit/Run script” tab of OpenACCEL](image)

At this moment it is possible to enter a definition into the script line input field. Add the following (new) definition into the field: ‘\( y = \text{pow}(x, 2) \)’. As a result OpenACCEL list down the dependencies which still have to be defined. In this case ‘x’ still have to be defined.
Next ‘x’ will be defined since it still have to be done. As stated ‘x’ will vary between [-5,5], therefore let ‘x’ be an input variable containing a slider with a default value of 0, a minimum of -5 and a maximum of 5. Hence, ‘x = slider(0, -5, 5)’:

Now when slide through the domain of ‘x’ the output value of ‘y’ will change as well, corresponding to the function \( y = x^2 \) over a domain of [-5,5].

### 3.3.4 Likely Errors

- Unsupported webbrowser
- Server offline

### 3.4 Delete definition

#### 3.4.1 Functional Description

This tutorial is about deleting a definition from a script and it starts where tutorial 3.3 ends.

#### 3.4.2 Cautions and Warnings

- Deleting a quantity definition is permanent. It cannot be recovered.
• When deleting a quantity that is being used in other quantity definitions, you must redefine it before you can run the script.

3.4.3 Procedures

As stated this tutorial will start where tutorial 3.3 has ended, hence the following screen has to appear on the screen:

Figure 3.11: Result after completing tutorial 3.3

Now this tutorial is about deleting definitions. In OpenACCEL it is very intuitive and easy to delete definitions since the only thing to do is to click on ‘delete’ right next to a definition:

Figure 3.12: How to delete a definition from a script

What is left is deleting a definition, hence click ‘delete’ right of ‘x = slider(0, -5, 5)’ and the definition is deleted successfully.
3.4.4 Likely Errors

- Unsupported webbrowser
- Server offline

3.5 Load script from “IO / Edit” tab

3.5.1 Functional Description

This tutorial is about loading a script from the “IO / Edit” tab.

3.5.2 Cautions and Warnings

- Loading a script will overwrite your current script

3.5.3 Procedures

This tutorial will start from the homepage of OpenACCEL (www.keesvanoverveld.com/Accel/accel.htm). To load a demo script from the “IO / Edit” tab in OpenACCEL click the “IO / Edit” tab. Now the following screen will show up:
Instead of entering definitions in sequence, it is possible to enter a whole script into the *Script* input field from the “IO / Edit” tab. For instance copy and pasting the following

Now when switching to the “Edit / Run script” tab the script is loaded and the following screen will appear:

3.5.4 Likely Errors

- Unsupported webbrowser
- Server offline

3.6 Execute model

3.6.1 Functional Description

This tutorial is about the execution of a script. A script can either run or pause.

3.6.2 Cautions and Warnings

None.
3.6.3 Procedures

To show the execution of a model the history operator will be used. Hence add the following definitions to the script input field:

![Figure 3.17: Script which is paused, using the history operator](image)

Now when the definitions are added to the script line the result will increment by one continuously. When clicking the “Pause” button, the script will stop executing and the result will stop incrementing. Hence when clicking the “Run” button, the result will increment again.

3.6.4 Likely Errors

When an error occurs during the execution of the model, execution is aborted and the error is displayed on screen. You can either try to run the model again right away or modify the model and then try again.

3.7 Optimize parameters using SPEA

3.7.1 Functional Description

This tutorial is about optimising parameters using Pareto.

3.7.2 Cautions and Warnings

- The Pareto functions are not used, hence the “Genetic Optimisation” tab cannot be displayed.

3.7.3 Procedures

In order to optimize parameters using SPEA, Pareto functions are needed. Hence, use the following script for the rest of this tutorial:
Since pareto functions have been used a switch to the “Genetic Optimisation” tab can be made. After switching to the “Genetic Optimisation” tab, the following screen will appear:

![Figure 3.19: The view of the “Genetic Optimisation” tab](image)

Now to calculate which input values will optimize the problem an initialisation have to be made. Hence, click the “Initialise” button to initialise a generation. Figure 3.20 shows a possible generation since the initialisation of a generation is completely random.

![Figure 3.20: A possible generation](image)
Figure 3.20 now shows which input values will give the optimised outcome. These optimised values are the on the so-called Pareto front and are visualised with the red dots. Hence, when clicking these red dots information will be given about which input values gives the optimised output values.

### 3.7.4 Likely Errors

- Unsupported webbrowser
- Server offline
- Pareto functions are not used
Chapter 4

Reference

This chapter is about the references which occur based on the tabs of the OpenACCEL webpage (http://www.keesvanoverveld.com/Accel/accel.htm)

4.1 Intro

4.1.1 Functional Description

This screen is shown when a user goes to the OpenACCEL website. It shows an introduction page which declares to what extend OpenACCEL can be used for.

4.1.2 Cautions and Warnings

None, unless the website is offline or the website is not supported by the browser used.

4.1.3 Formal Description

The user can perform the operation as given in table 4.1.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Steps</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edit / Run script</td>
<td>Click on the Edit / Run script tab</td>
<td>The screen will change to the Edit / Run script view</td>
</tr>
<tr>
<td>Help / Demo</td>
<td>Click on the Help / Demo tab</td>
<td>The screen will change to the Help / Demo view</td>
</tr>
<tr>
<td>IO / Edit</td>
<td>Click on the IO / Edit tab</td>
<td>The screen will change to the IO / Edit view</td>
</tr>
<tr>
<td>Genetic Optimisation</td>
<td>Click on the Genetic Optimisation tab</td>
<td>The screen will change to the Genetic Optimisation view</td>
</tr>
</tbody>
</table>

Table 4.1: Operations in the Intro tab

4.1.4 Examples

From the Intro tab, homepage, click any tab and the view will change to the tab clicked.
4.1.5 Possible Errors
None.

4.1.6 Related Operations
- Section 4.2
- Section 4.3
- Section 4.4

4.2 Edit / Run script

4.2.1 Functional Description
This screen is shown when a user clicks on the “Edit / Run script” tab from the homepage.

4.2.2 Cautions and Warnings
None.

4.2.3 Formal Description
The user can perform the operation as given in table 4.2.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Steps</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro</td>
<td>Click on the Intro tab</td>
<td>The screen will change to the Intro view</td>
</tr>
<tr>
<td>Help / Demo</td>
<td>Click on the Help / Demo tab</td>
<td>The screen will change to the Help / Demo view</td>
</tr>
<tr>
<td>IO / Edit</td>
<td>Click on the IO / Edit tab</td>
<td>The screen will change to the IO / Edit view</td>
</tr>
<tr>
<td>Genetic Optimisation</td>
<td>Click on the Genetic Optimisation tab</td>
<td>The screen will change to the Genetic Optimisation view</td>
</tr>
<tr>
<td>Add definition</td>
<td>Enter a definition in the Script line input field</td>
<td>A definition is added to the script</td>
</tr>
<tr>
<td>Enter</td>
<td>Click on the ‘Enter’ a definition in the Script line input field</td>
<td>A definition is added to the script</td>
</tr>
<tr>
<td>Pause</td>
<td>Click on the ‘Pause’ button</td>
<td>The script is paused and the ‘pause’ button switched to a ‘run’ button</td>
</tr>
<tr>
<td>Run</td>
<td>Click on the ‘Run’ button</td>
<td>The script start running and the ‘run’ button switched to a ‘pause’ button</td>
</tr>
<tr>
<td>New</td>
<td>Click on the ‘New’ button</td>
<td>The whole script will be deleted</td>
</tr>
</tbody>
</table>
4.2.4 Examples

First set the number of iterations to 1500. Next add a definition, for instance \( a = b \). After add another definition, \( b = b \{1\} + 1 \). Now ‘a’ is incrementing by one continuously, hence when clicking the ‘pause’ button the result stops incrementing. Now when clicking the ‘run’ button, the result starts incrementing again till 1500, since the number of iterations is set to 1500. Finally when clicking the ‘new’ button the whole script gets deleted. Alternatively, it is possible to click the ‘delete’ next to each definition.

4.2.5 Possible Errors

None.

4.2.6 Related Operations

- Section 4.1
- Section 4.3
- Section 4.4

4.3 IO / Edit

4.3.1 Functional Description

This screen is shown when a user clicks on the “IO / Edit” tab from the homepage.

4.3.2 Cautions and Warnings

None.

4.3.3 Formal Description

The user can perform the operation as given in table 4.3.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Steps</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro</td>
<td>Click on the Intro tab</td>
<td>The screen will change to the Intro view</td>
</tr>
<tr>
<td>Edit / Run script</td>
<td>Click on the Edit / Run script</td>
<td>The screen will change to the Edit / Run script view</td>
</tr>
</tbody>
</table>

Table 4.2: Operations in the Edit / Run script tab
4.3.4 Examples
Copy paste a given script into the Script input field.

4.3.5 Possible Errors
None.

4.3.6 Related Operations
- Section 4.1
- Section 4.2
- Section 4.4

4.4 Genetic Optimisation

4.4.1 Functional Description
This screen is shown when a user clicks on the “Genetic Optimisation” tab from the homepage.

4.4.2 Cautions and Warnings
The “Genetic Optimisation” tab can only be used when Pareto functions are declared in the script.

4.4.3 Formal Description
The user can perform the operation as given in table 4.4.
### Operation Steps Result

<table>
<thead>
<tr>
<th>Operation</th>
<th>Steps</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro</td>
<td>Click on the Intro tab</td>
<td>The screen will change to the Intro view</td>
</tr>
<tr>
<td>Edit / Run script</td>
<td>Click on the Edit / Run script tab</td>
<td>The screen will change to the Edit / Run script view</td>
</tr>
<tr>
<td>Help / Demo</td>
<td>Click on the Help / Demo tab</td>
<td>The screen will change to the Help / Demo view</td>
</tr>
<tr>
<td>IO / Edit</td>
<td>Click on the IO / Edit tab</td>
<td>The screen will change to the IO / Edit view</td>
</tr>
<tr>
<td>Population size</td>
<td>Set the population size</td>
<td></td>
</tr>
<tr>
<td>Initialise</td>
<td>Click the “Initialise” button</td>
<td></td>
</tr>
<tr>
<td>Generations per click</td>
<td>Set the number of generation per click</td>
<td></td>
</tr>
<tr>
<td>Generate next</td>
<td>Click the “Generate next” button</td>
<td></td>
</tr>
<tr>
<td>Crossover</td>
<td>Set the crossover percentage</td>
<td>The percentage of the population that mates with each other</td>
</tr>
<tr>
<td>Mutation distribution</td>
<td>Set the mutation distribution</td>
<td></td>
</tr>
<tr>
<td>Maximum on front</td>
<td>Set the maximum on front percentage</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.4: Operations in the Genetic Optimisation tab

#### 4.4.4 Examples

Click the “initialise” button to see which individuals are on the pareto front to see which input values will optimise the model.

#### 4.4.5 Possible Errors

None.

#### 4.4.6 Related Operations

- Section 4.1
- Section 4.2
- Section 4.3
Appendix A

Error Messages and Recovery Procedures

This chapter is about which errors can occur throughout using OpenACCEL. Also the recovery procedures will be explained.

A.1 Syntax errors

Syntax errors are errors which can occur by wrong use of the OpenACCEL language. These errors can be recovered by following the error message which will pop up when such syntax error occur.

A.2 Runtime errors

Runtime errors are errors which can occur during compilation of a script
**Appendix B**

**Glossary**

<table>
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<th>Term</th>
<th>Description</th>
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<td>ACCEL</td>
<td>The ACCEL-system is a light-weight, general purpose modelling environment for mathematical modelling. It combines some ideas from spreadsheets, Matlab, and traditional high-school mathematics</td>
</tr>
<tr>
<td>OpenACCEL</td>
<td>Have the same functionalities as ACCEL, instead it will be opensourced</td>
</tr>
<tr>
<td>Genetic Optimisation</td>
<td>Optimisation method which uses SPEA</td>
</tr>
<tr>
<td>SPEA</td>
<td>An algorithm which is used to calculate the Pareto front</td>
</tr>
<tr>
<td>Pareto front</td>
<td>The set of all (Pareto) optimal outcomes</td>
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