DOCUMENT

Preliminary

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Preliminary report

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Preliminary report

Development of a C++ based user-interface for a plasma simulation tool

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14 October 2016

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..... DATE
.....
.....

[1] Repetitive word: *material*

[2] Repetitive word: *work*

Abstract

An existing microplasmas simulation tool which developed by the technological plasma team will generate numerous [3] output data in various formats. Thus a user-friendly-interface [4] is needed by relevant researchers and industry users.
This report is aimed to describe the preliminary development procedures of this user-friendly-interface [5] and it will be divided [6] into 6 [7] parts which are project description, methodology, project plan, project rationale with industrial [8] relevance, literature review and the working [9] result in the first three weeks.
The future work of this project will in terms of [10] the project plan in continuing research.

[3] Better word pair

[4] Possibly confused word: *user-friendly-interface*

[5] Missing comma in compound sentence

[6] Passive voice

[7] [6 → six]

[8] Better word pair

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[9] Better word pair

[10] [in terms of → regarding]

[11] [**statements** → **Statements**]

[12] [**overview** → **Overview**]

Introduction

This preliminary report will be divided [17] into 6 [18] main parts:

First is the project description. The overview, aims and objectives of this project will be mentioned and then the general ways to realize [19] these aims [20] will be described [21].
Second [22] part is the methodology. The specific tools and technological processes of this project will be explained [23].
Third [24] part is project plan and Gantt chart. This project is combined [25] from [26] a large amounts [27] of specific tasks with duty

[13] [form → forms]

[14] Possibly confused word: *preferable*

[15] [**project** → **Project**]

[16] [form → forms]

[17] Passive voice

[18] [~~6~~ → six]

cycle [28] and then it will be used to generate the Gantt chart for managing the task [29] progress.

After that is [30] project rationale and industrial relevance. The evaluation of this project and the research interests of project supervisor will be used to analysis this project and the relationship with industry.

And then is the literature review. The relevant research results of other people will be browsed and displayed as reference [31] list.

Last part is the result [32]. Preliminary research result of this project in the first three weeks will be introduced [33].

Project Description

2.1 Problem statements

The Technological Plasma Group has developed a simulation too [34] for microplasmas which called Plasimo [35]. Large [37] amount [36] of output files will be generated [38] through simulated these models of plasma. Plasimo [39] 5.0 developer version and the Micro Discharge 2D (md2d) model of plasma will be applied [40] on this project. The running process of this simulated tool is shown [41] as [42] Figure 1.

Figure 1. Running process of Plasimo [43] 5.0 with md2d model

After finished the simulated process, large [44, 45] amount of output files will be generated as text and out formats which is shown [46] as [47] Figure 2.

Figure 2. Output files of md2d model simulation

Lots of information of simulated plasma are stored [48] as specified in these files. The explanation of each files [49] will be shown in Table 1[1].

19 [realize → realise]

20 Repetitive word: *aims*

21 Passive voice

22 [Second → The second]

23 Passive voice

24 [Third → The third]

25 Passive voice

26 [combined **from** → combined **with**]

27 [a large amounts → large amounts]

28 [cycle**,**]

29 Repetitive word: *task*

30 [is → are]

31 [**a** reference or **the** reference]

32 Repetitive word: *result*

33 Passive voice

34 Possibly confused word: *too*

35 [**Plasimo** → Plas**ma**]

36 [Large amount → A large amount]

37 [Large → A Large]

38 Passive voice

39 [**Plasimo** → Plas**ma**]

40

41 Passive voice
Passive voice

42 [shown **as** → shown **in**]

43 [**Plasimo** → Plas**ma**]

44 [**a** large or **the** large]

45 Overused word: *large*

n00.txt
electron energy density [J m-3]
phi00.txt
electron energy flux density [W m-2]
S00.txt
electron energy source [W m-3]
D00.txt
electron energy diffusion coefficient [W m2]
mu00.txt
electron energy mobility coefficient [J m2 V-1 s-1]
Relas00.txt
rate of electron energy loss from elastic collisions [W m-3]
epsilon.txt
mean electron energy [J]
n01.txt
density for species 1 [m-3]
S01.txt
source for species 1 [m-3 s-1]
D01.txt
diffusion for species 1 [m2 s-1]
mu01.txt
mobility for species 1 [m2 V-1 s-1]
phi01.txt
flux for species 1 [m-2 s-1]
R00.txt
reaction rate for reaction 1 [m-3 s-1]
K00.txt
reaction rate coefficient for reaction 1 [m3 s-1]

46 Passive voice

47 [shown **as** → shown **in**]

48 Passive voice

49 [files → file]

Pp01.txt
power dissipation for species 1 [W m-3]
P.txt
dissipated power density [W m-3]
J.txt
current density [C s-1 m-3]
V.txt
potential [V]
E.txt
electric field [V m-1]
Er.txt
reduced electric field E/p [V m-1 Pa-1]
E_N.txt
reduced electric field E/N [V m2]
rho.txt
volume charge density [C m-3]
sigma.txt
surface charge density [C m-2]
info.txt
the averaged values written with the user-specified frequency
info.out
the averaged values
history.out
gives the calculated variables as a function of time

Table 1. The explanation of each simulated output files from plasimo [50] user guild

For plasma model md2d, a long [51] simulated time is needed to run the md2d model in the plasimo [52]. In addition [53], there are total 68 output files with 32.9 MB data, different files represent different data of plasma as shown in Table 1, thus [54] researchers and industry users are complicated read these data, moreover, a number of [55] these data are useless to them.

2.2 Project overview [56]

According to the problem statements, a software [57] with user-friendly-

interface [58] is needed to developing. Therefore, the aim of this project is to develop a practical C++ based user-interface to help researchers and industry users obtain significant output data effectively [59].

This project could be divided [60] into 2 [61] main [62] objectives:

First is research of plasma to select useful data from numerous [63] output data because the significant data are needed to pick at the beginning to reduce the workload of programming. Thus, background reading and research for plasma discharges will be involved [64] as [65] an initial phase of this project.

Second and the key aspect of this project is develop the widely accessible user-interface to help researchers and industry users. The skill of developing interface by using C++ based tools should be trained [66].

In order to [67] achieve this project within 20 weeks, it need [68] developer working by combined research work and programming skill together. At the meanwhile, the report and presentation of this project should be prepared [69]. More detail about how to realize [70] this project will be discussed [71] in the Methodology part.

Methodology

Tools

3.1.1 C++ based software developing tools

The requirement of this project is under C++ developing environment. 3 [72] main [73] tools will be used to build this user-interface.

3.1.1.1 Microsoft Visual Studio Community 2013

Visual Studio is the most popular integrated development environment on Windows. It will be used [74, 75] for the main [76] developing tool in this project.

3.1.1.2 Qt 5.7.0

Qt is a framework of cross-platform C++ graphical user interface (GUI) application development. it [77] contains the fundamental technology of GUI which is used to render the interface [2].

3.1.1.3 openGL

Open Graphics Library (OpenGL) is the most widely 2D and 3D Application Program Interface (API). It could applicate in lots of platforms such like Window, Linux and MacOS.

50 [**plasimo** → plas**ma**]

51 Possibly miswritten word: *a long*

52 [**plasimo** → plas**ma**]

53 [In addition → Also]

54 [1**, thus** → 1**. Thus**]

55 [a number of → some]

56 [**overview** → **Overview**]

57 [**a** software]

58 Possibly confused word: *user-friendly-interface*

59 Overused word: *effectively*

60 Passive voice

61 [~~2~~ → two]

62 Overused word: *main*

63 Better word pair

64 Passive voice

65

Software Development Process

3.2.1 Software requirements

This program is used to display required data by processing large amount [78] of text files [79] and it should be used to select significant data of plasma to researchers and industry users.

Figure 3. The general analysis of this project

According to analysis the characters of this original [80] GUI in Plasimo [81], it could find it is complicated because new users are hard to run this software without handbook [82]. At the same time, redundant output data will be generated [83] through the simulated process, researchers and users cannot find useful data efficient. For m2de model, it cost 10 minutes to run simulation [84]. However, there still has other models [86] of plasma are more time-consuming.[85]

In order to [87] solve these problems, it could find the software requirements are an accessible [88], simplified and fast GUI to support useful data to users. This analysis process is shown [89] as [90] Figure 3 [91] and the design process of this project will follow this analysis [92].

3.2.2 Design

In order to [93] realize [94] requirements of this software, accessible, simplified and fast will be consider [95] as the key points of the design process.

3.2.2.1 User-interface building

In order to [97] develop [96] an accessible user-interface, the key aspect is it should obey the Eight Golden Rules of Interface design [3].

Strive for consistency

Cater to universal usability

Offer informative feedback

Design dialogs [98] to yield closure

Prevent errors

Permit easy reversal of actions

Support internal locus of control

Reduce short-term memory load

Possibly confused preposition

66 Passive voice

67 [In order to → To]

68 [need → needs]

69 Passive voice

70 [realize → realise]

71 Passive voice

72 [3 → Three]

73 Overused word: *main*

74 Passive voice

75 Repetitive word: *used*

76 Overused word: *main*

77 [it → It]

In addition [99], research interfaces of different software especially research-based software are significant.

The soul of this project is user-interface, thus [100] it needs to spend more time to compare advantages and disadvantages of different interfaces in [101] continuing research.

3.2.2.2 3D graphical display function

For technology users, the output simulated data of plasma should be displayed intuitionistic. Therefore, 3D [102] graphical model could be treated [103] as a simplified and intuitionistic way to research plasma. Users could observe the changing process of particular plasma model.

3.2.2.3 Rapid loading text files function

Excellent [104] reasoned time of a software [105] should be considered [106] as an important standard. Numerous output data will be generated by md2d plasma simulation [107, 108] and other models of plasmas may spend longer time to obtain results. In addition [109], there are 68 output files of one simulated plasma, thus the rapid text files loading function is needed [110] to researching and developing fast [111] interface.

Project Plan

4.1 FYP

4.1.1) Preparatory Work

4.1.1.1) Obtain plasma simulation tool and relevant reading materials

4.1.2) Research Work

4.1.2.1) Weekly background reading for plasma discharges.

4.1.2.2) Investigating significant data in numerous [112] output file.

4.1.2.3) Investigating Interface of learning, researching and factory software.

4.1.2.4) Literature review.

4.1.2.4) Learning of corresponding [113] software include C++ based visual studio, openGL [114] and Qt.

4.1.3) Developing Work

4.1.3.1) Write software requirements

4.1.3.1.1) software specifications

4.1.3.1.2) software analysis

4.1.3.2) Design

78 [large amount → a large amount]

79 [files,]

80 Better word pair

81 [**Plasimo** → Plas**ma**]

82 [**a** handbook or **the** handbook]

83 Passive voice

84 [**the** simulation or **a** simulation]

85 Incomplete comparison

86 Repetitive word: *models*

87 [In order to → To]

88 Better word pair

89 Passive voice

90 [shown **as** → shown **in**]

91 [3,]

92 Repetitive word: *analysis*

93 [In order to → To]

94 [realize → realise]

95 [be consider → be considered]

96 Repetitive word: *order*

97 [In order to → To]

4.1.3.2.1) Rapid loading text files function developing.

4.1.3.2.2) 3D graphical model displayed function developing [115].

4.1.3.2.3) Intuitive user-interface developing.

4.1.3.3) Testing and improving

4.1.3.3.1) Program test and debug.

4.1.3.3.2) Development methodology.

4.1.4) Report Work

4.1.4.1) Writing project specification report form.

4.1.4.2) Writing Preliminary report.

4.1.4.3) Weekly virtual log book.

4.1.4.4) Preparing presentation.

4.1.4.5) Creating poster.

4.1.4.6) Writing final [116] report.

The complicated project plan will be shown [117] in Appendix 2 with the Gantt chart.

Project Rationale and Industrial Relevance

In this project, the major [118] areas related are computer science and physical, which are both significant [119] branches of human scientific and technological development. In addition [120], the relationship of [121] these two areas [122] and EEE are not closely. Therefore, this is a more challenging opportunity to test the learning ability of new areas as a EEE [123] undergraduate.

For the continuing development, high [124] value of this project could be created [125] because there are many applications on plasma [126]. For example, microplasmas for biomedical [127] is an important [128] application [129]. The plasma needle could be used [130] to product [131] reactive species such as excited molecules, radicals and ions [4]. In this case, the properties of the plasma needle can be displayed and investigated in simulation tool which is shown [132] as [133] Figure 4.

Figure 4. Simulation of the plasma needle

Source: Numerical description of discharge characteristics of the plasma needle

98 [dialogs → dialogues]

99 [In addition → Also]

100 [user-interface**, thus** → user-interface**. Thus**]

101 Repetitive word: *different*

102 [**the** 3D or **a** 3D]

103 Passive voice

104 [Excellent**,**]

105 [**a** software]

106 Passive voice

107 Passive voice

108 [simulation**,**]

109 [In addition → Also]

110 Passive voice

111 [**the** fast]

Literature Review

At the preliminary stage, 3 [134] literatures [135] related to this project has been found [136] through the university library database. Two of them are related to web-based [137] user-interface [138, 139] and the remaining one is related to software interface developing of plasma tools.

To better understand the characters of user-interface design, R.R. Zhang, B.J. Xiao, Q.P. Yuan, F. Yang, Y. Zhang, R.D. Johnson, B.G. Penaflor (2014) illustrates the clearly [140] design process of GUI, they [141] have excellent [142, 143] workflow to deliver their ideas. However, the completed interface is not adequate quality as their design process. M. Emoto, S. Murakami, M. Yoshida, H. Funaba and Y. Nagayama (2007) developed neat [144, 145] interface which could display the data of plasma into formulas and line charts. S. Anett, L. Heike, S. Jörg (2007) described the detailed design process of GUI and the most impressive [146] idea is give [147] the user specialized [148] tools for specific tasks within the control system.

For summarizing [149] these 3 [150] literatures [151], web-based interfaces are developed by JavaScript, but the concept of GUI design process is worth to study, both clear explanations and flow charts are needed to display the interface. Moreover, thinking more of users is the most important factor to develop a wonderful [153] GUI [152].

[112] Better word pair

[113] Better word pair

[114] [**openGL** → OpenGL]

[115] Repetitive word: *developing*

Literature reviews appendix

M. Emoto, S. Murakami, M. Yoshida, H. Funaba and Y. Nagayama., " Web interface for plasma analysis codes", J. Appl. Phys. vol. 83, no.2-3, pp. 453-457, April 2008, DOI: 10.1016/j.fusengdes.2007.10.008

S. Anett, L. Heike, S. Jörg, " User control interface for W7-X plasma operation", J. Appl. Phys. 2007, DOI: 10.1016/j.fusengdes.2007.05.052

R.R. Zhang, B.J. Xiao, Q.P. Yuan, F. Yang, Y. Zhang, R.D. Johnson, B.G. Penaflor, " The web-based user interface for EAST plasma control system", J. Appl. Phys. February 2014, DOI: 10.1016/j.fusengdes.2014.02.070

[116] [**a** final or **the** final]

[117] Passive voice

[118] Overused word: *major*

[119] Better word pair

Results

Plasma is a new area of EEE student, thus [154] this project contains two main parts which are deep learning about plasma and user-interface developing.

At the preliminary stage, research basic [155] properties of plasma and develop specific [156] function are two main result [157] in the first 3 [158] weeks.

7.1 Preliminary research [159] of plasma

7.1.1 Plasma and Micro Discharge 2D(md2d) model

7.1.1.1 Plasma definition

Plasma is one of the four fundamental states of matter, it [160] is part of ionized [161] gas which consists of electron [162], ion, free radical, neutral ion and photon.

The general type of plasma will be applied [163] at this project which is shown [164] in Figure 5.

Figure 5. The general [165] image of a plasma

According to figure 5, it could be observed [166] that the general plasma has a vacuum chamber, pump, a gas flow system and electrodes.

In addition [167], the plasma has various significant features which are:

Sheath layer

Different types of particles

Reactions in the plasma

Power input and loss of the plasma

Gas flow into and out of the chamber.

A large [169] amount of [168] output files is generated [170] through the Plasimo [171] simulation tool [172] and the explanation of each output files [173] is shown [174] in Table 1. It described 24 properties of plasma.

However, the most basic plasma properties are:

Gas Density and pressure

Neutral particle density

Electron density

Electron energy and electron temperature

Ion density

Plasma potential

120 [In addition → Also]

121 Possibly confused preposition

122 Repetitive word: *areas*

123 [a EEE → an EEE]

124 [**the** high or **a** high]

125 Passive voice

126 [**the** plasma or **a** plasma]

127 [**biomedical** → **Biomedical**]

128 Overused word: *important*

129 Repetitive word: *application*

130 Passive voice

131 Possibly confused word: *product*

132 Passive voice

133 [shown **as** → shown **in**]

134 [~~3~~ → three]

135 [literatures → kinds of literature]

136 Passive voice

137 [**web-based** → **Web-based**]

138 Possibly confused word: *user-interface*

139 [user-interface**,**]

140 [clearly → clear]

141 [GUI**, they** → GUI**; they**]

142 [**an** excellent or **the** excellent]

143 Better word pair

Ionization ratio

7.1.1.2 md2d model definition

Micro Discharge 2D (md2d) is the target model in this project. It is a time dependent [175] model and the function of it is solve particle transport problem in conjunction [5].

7.2 Preliminary developing of software

7.2.1 Rapid loading text files function

There are 68 text files with 32.9 MB data of simulated md2d model. Moreover, other models of plasma may generate more data, thus to improve the response speed of this software, the stable [176] and fast text load command should be chosen [177].

For searching on the internet, there are four commands to load data of text file in C++ environment.

In order to [178] test these command [179], it need [180] to generate a text file with 10000000 random number first, and the different loading command will be used to test [181] the loading time of this files [182].

Scanf [183] is the normal [184] loading command in C++.

Figure 6. Code of testing scanf [185] command

cin [186] is the most common loading command [187] in C++.

Figure 7. Code of testing cin [188] command

Fread [189] command is used to load all data into one string

Figure 10. Code of testing fread [190] command

Visual Studio 2013 command

Time (s)

scanf

3.8

cin

21.6

144 [**a** neat or **the** neat]

145 Better word pair

146 Better word pair

147 [give → to give]

148 [specialized → specialised]

149 [summarizing → summarising]

150 [~~3~~ → three]

151 [literatures → kinds of literature]

152 To-infinitive instead of prepositional phrase

153 Overused word: *wonderful*

154 [student**, thus** → student**. Thus**]

fread

0.42

Table 2. Testing result of loading command.

According to analysis these result, it could find command fread [191] has the most efficient speed to load files, thus [192] this command will be used as the first choose to loading data.

However, this is only the preliminary test of this function. All test focused on one text file, but there are 68 text files of the simulated output. Thus, the rapid [193] loading text files function [194] still need further development.

Conclusion

In general, this preliminary report is the initial [195] guild of the Final Year Project which is development [196] of a C++ based user-interface for a plasma simulation tool. It can be divided [197] into six parts include project [198] description, methodology, relevant plan, project rationale, literature review and the result. The aim and objective are developing a user-friendly-interface [199] to help researchers and industry users to investigate plasma effective [200].

The ability of formulate [201] a project plan and preliminary work are trained [202] through this process. After finish this report, the understanding of the project will be increased, so that it will support convenience to the future development. However, it is still the beginning of this FPY, the details about interface design and relevant [203] programming need more time to investigate.

References List

[1] The Plasimo [204] Team. (2014 April) IEEE Citation Reference [online]. Available: https://plasimo.phys.tue.nl/generated-docs/plasimo-5.0.0/misc-docs/user_guide.pdf (accessed 14th October 2016)

[2] D. Molkentin, "The Book of Qt 4: The Art of Building Qt Applications". San Francisco, USA: No Starch Press, 2007, ISBN-13 978-1593271473

[3] B. Shneiderman. (2010) IEEE Citation Reference [online].

155 Overused word: *basic*

156 Overused word: *specific*

157 [result → results]

158 [3 → three]

159 Repetitive word: *research*

160 [matter**, it** → matter**; it**]

161 [ionized → ionised]

162 [**the** electron or **an** electron]

163 Passive voice

164 Passive voice

165 Repetitive word: *general*

166 Passive voice

167 [In addition → Also]

168 [A large amount of → A lot of]

169 Overused word: *large*

170 Passive voice

171 [**Plasimo** → Plas**ma**]

172 [tool**,**]

173 Repetitive word: *files*

174 Passive voice

Available: https://www.cs.umd.edu/users/ben/goldenrules.html (accessed 14th October 2016)

[4] W.J.M. Brok, M.D. Bowden, J. van Dijk, J.J.A.M. van der Mullen and G.M.W. Kroesen., " Numerical description of discharge characteristics of the plasma needle", J. Appl. Phys. vol. 98, 2005, DOI: 10.1063/1.1944218

[5] The Plasimo [205] Team. IEEE Citation Reference [online]. Available: https://plasimo.phys.tue.nl/physics/md2d/index.html (accessed 14th October 2016)

Appendices

Appendix 1. The specification report [206] form

Appendix 2. A Gantt chart preferable [207] produced by MS project [208]

Appendix 3. The risk assessment form

Appendix 4. Ethical approval questionnaire

[175] [**time dependent** → time-dependent]

[176] Better word pair

[177] Passive voice

[178] [In order to → To]

[179] Repetitive word: *command*

[180] [need → needs]

[181] Repetitive word: *test*

[182] Repetitive word: *files*

[183] [**Scanf** → Scarf]

[184] Overused word: *normal*

[185] [**scanf** → scan]

[186] [**cin** → can]

[187] Repetitive word: *command*

[188] [**cin** → in]

[189] [**Fread** → Fred]

[190] [**fread** → read]

191 [**fread** → thread]

192 [files**, thus** → files**. Thus**]

193 Better word pair

194 Repetitive word: *function*

195 Better word pair

196 [**the** development or **a** development]

197 Passive voice

198 [**a** project or **the** project]

199 Possibly confused word: *user-friendly-interface*

200 [effective → effectively]

201 [of formulate → to formulate]

202 Passive voice

203 Better word pair

204 [**Plasimo** → Plas**ma**]

205 [**Plasimo** → Plas**ma**]

206 [report → reports]

207 Possibly confused word: *preferable*

208 [**project** → **Project**]