AN AUTONOMOUS METHOD FOR MEASURING 3D JOINT KINEMATICS FROM 2D XRAY IMAGES

By

ANDREW JAMES JENSEN

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
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2021

This is the dedication tex file, which should have been set in the main file using the command `\setDedicationFile{Drive:/file/location/dedicationFile}`. Keep in mind this should be written in first person; eg “I dedicate this to all those people that let me crawl into a cave and disappear while I learned way too much about way too specific of a subject in order to make a meaningful contribution to my field.”

ACKNOWLEDGEMENTS

This is the acknowledgments tex file, which should have been set in the main file using the command `\setAcknowledgementsFile{Drive:/file/location/acknowledgementsFile}`.

Keep in mind this should be written in first person, eg; “I thank my chair for his patience with my random tangents and endless questions and his subsequent (and often lengthy) explanations. I especially appreciate him refraining from voicing how dumb some of those questions were, despite me feeling like a moron nonetheless.”

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LIST OF ABBREVIATIONS

$\sum$	Denotes the summation of a series of terms
$\bigcap$	A really big bigcap
fractal	A geometric pattern that is repeated at ever smaller scales to produce irregular shapes and surfaces that cannot be represented by classical geometry. Fractals are used especially in computer modeling of irregular patterns and structures in nature.
polynomial	(in one variable) an expression consisting of the sum of two or more terms each of which is the product of a constant and a variable raised to an integral power: $ax^2 + bx + c$ is a polynomial, where a, b, and c are constants and x is a variable.

Abstract of Dissertation Presented to the Graduate School
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AN AUTONOMOUS METHOD FOR MEASURING 3D JOINT KINEMATICS FROM 2D XRAY IMAGES

By

Andrew James Jensen

August 2021

Chair: Scott Banks
Major: Mechanical Engineering

This is the abstract tex file, which should have been set in the main file using the command `\setAbstractFile{Drive:/file/location/abstractFile}`.

This is what will appear in the place of an abstract, no formatting or other content is needed, just fill this file with your actual abstract, eg; In this paper we give examples of the various files and configurations used in the graduate school LaTeX template for dissertations and thesis papers.

CHAPTER 1
INTRODUCTION AND OPENING REMARKS

We automatically capitalize all chapters, but if you need to suppress this you can use the class option "overrideTitles" and/or "overrideChapter" to allow you to use non-capitalized letters in the title and/or chapter names respectively. For more detailed information on the template's features and options, see the included file "ufdissertation-Doc-and-Troubleshooting".

* We don't recommend that you change much of anything in the class file unless you're absolutely sure of what your are doing.[1]

1.1 The Section Command Text Should Be in Title Case

Title case is where all principal words are capitalized except prepositions, articles, and conjunctions.

1.1.1 Subsection Commands Are Also in Title Case

The difference, of course, are the second level headings are left-aligned

1.1.1.1 Subsubsections are in sentence case

The third level subheadings are left-aligned but in sentence case. Only the first letter and any proper nouns are capitalized.

1.1.1.2 If you divide a section, you must divide it into two, or more, parts

Paragraph headings. There is no official fourth level heading. Do not use the Paragraph heading feature in LaTeX, simply apply the bold characteristic to the first few words of a paragraph followed by a colon or period.

1.1.2 I Need Another Second Level Heading in This Section

Aliquam mi nisi, tristique at rhoncus quis, consectetur non mi. Phasellus blandit quam ligula, a viverra lacus commodo at. In iaculis nisl vel pretium sollicitudin. In efficitur massa vel elit sollicitudin, vel auctor sapien cursus. Proin feugiat sapien a mi tempus;

$$X - X' = D + D'$$

in consequat augue cursus. Nulla sed sagittis purus. Nunc eu consequat orci, eu laoreet enim. Ut euismod tincidunt sem, eget lacinia dui luctus eu. Aliquam mi augue, faucibus id

*an un-numbered footnote - this is how you tell the readers that this chapter was previously published and then cite the Journal where it was published

[1] and now we're back to normal footnote marking

semper vitae, porta ac ligula. Morbi sed ultrices odio. Mauris id luctus ex. Nulla ac libero dictum, interdum turpis lacinia, scelerisque leo. Praesent varius orci ac eros varius pharetra.

CHAPTER 2
LITERATURE REVIEW

2.1 Dolor Sit Amet

Many of the problems in theses and dissertations involve tables. The UF Graduate Counsel is very specific in the Table Requirements.There should be no vertical lines in tables and only three horizontal lines. No bold text, etc., see the web site for the complete list of requirements. One simple improvement can be incorporated by using tabularx instead of the tabular environment. This allows a table to be stretched the full text width easily, which avoids the centered or left aligned issue. Table A-1 is an examble of the tabularx code. Consectetur adipiscing elit. Fusce eget tempus lectus, non porttitor tellus. Aliquam molestie sed urna quis convallis. Aenean nibh eros, aliquam non eros in, tempus lacinia justo. In magna sapien, blandit a faucibus ac, scelerisque nec purus.

Table 2-1. A sample Table using tabularx

First	Second	Third
12	45	26
17	32	93
text	51	can be there too.

Praesent fermentum felis nec massa interdum, vel dapibus mi luctus. Cras id fringilla mauris. Ut molestie eros mi, ut hendrerit nulla tempor et. Pellentesque tortor quam, mattis a scelerisque nec, euismod et odio. Mauris rhoncus metus sit amet risus mattis, eu mattis sem interdum.

Table 2-2. A sample Table using standard tablular

First	Second	Third
12	45	26
17	32	93
text	51	can be there too.

2.1.1 Platea Dictumst

Donec convallis scelerisque ante, in sollicitudin orci laoreet eu. Nam arcu magna, semper vel lorem eu, venenatis ultrices est. Nam aliquet ut erat ac scelerisque. Maecenas ut molestie mi. Phasellus ipsum magna, sollicitudin eu ipsum quis, imperdiet cursus turpis. Etiam pretium enim a fermentum accumsan. Morbi vel vehicula enim.

2.2 Ex id ullamcorper commodo

Augue sapien mattis leo, nec accumsan turpis quam at neque. Ut pellentesque velit sed placerat cursus. Integer congue urna non massa dictum, a pellentesque arcu accumsan. Nulla posuere, elit accumsan eleifend elementum, ipsum massa tristique metus, in ornare neque nisl sed odio. Nullam eget elementum nisi. Duis a consectetur erat, sit amet malesuada sapien. Aliquam nec sapien et leo sagittis porttitor at ut lacus. Vivamus vulputate elit vitae libero condimentum dictum. Nulla facilisi. Quisque non nibh et massa ullamcorper iaculis.

Integer laoreet bibendum arcu non pulvinar. Curabitur ac magna nibh. Phasellus sed nisi semper, molestie neque at, tempus lacus. Aenean vitae lacinia est. Phasellus aliquam lacus sit amet placerat molestie. Sed sit amet bibendum lectus, ac ornare ligula. Curabitur porttitor interdum tortor a dignissim. Quisque a placerat nibh. Phasellus lobortis imperdiet augue, non congue est bibendum eu. Vivamus tincidunt quam eu fringilla laoreet.

Maecenas efficitur dolor et ipsum convallis, ut fringilla neque luctus. Donec ac nisl quis leo gravida accumsan sit amet sed tellus. Quisque placerat hendrerit augue sit amet aliquet. Vestibulum laoreet consequat nunc, et egestas nisl auctor et. Duis scelerisque vulputate placerat. Proin tempus ligula ac tempor eleifend. Nullam est odio, commodo quis nisl eu, feugiat efficitur purus.

Duis egestas in mauris vel efficitur. Sed a faucibus sem, non euismod enim. Maecenas nec nulla justo. Suspendisse ut orci ac mi aliquet tincidunt ac eget quam. Quisque ac mi sagittis, dapibus dui a, facilisis neque. Aenean euismod orci sem, non imperdiet ipsum pulvinar ac. Proin eu vestibulum magna, eu ullamcorper nulla. Etiam enim felis, dignissim eget commodo ac, faucibus nec justo. Nulla condimentum velit imperdiet ligula aliquam semper. Nulla facilisi. Ut in lobortis metus, at dictum ipsum. Suspendisse facilisis nec eros eget mollis. Vestibulum eget dolor ac mauris lobortis gravida. Suspendisse consectetur orci in risus pharetra, sed eleifend nisl lacinia. Mauris augue nibh, commodo sed sem at, congue molestie massa. Suspendisse sodales aliquet tellus, a tristique nunc aliquam id.

CHAPTER 3
MATERIALS ANS METHODS

3.1 Consectetur Adipiscing Elit

Fusce eget tempus lectus, non porttitor tellus. Aliquam molestie sed urna quis convallis. Aenean nibh eros, aliquam non eros in, tempus lacinia justo. In magna sapien, blandit a faucibus ac, scelerisque nec purus. Praesent fermentum felis nec massa interdum, vel dapibus mi luctus. Cras id fringilla mauris. Ut molestie eros mi, ut hendrerit nulla tempor et. Pellentesque tortor quam, mattis a scelerisque nec, euismod et odio. Mauris rhoncus metus sit amet risus mattis, eu mattis sem interdum.

3.1.1 This Is an Isolated Heading

Either promote this to a section heading, add another subsection heading, or delete this heading. A random citation to demonstrate the bibliography; [2]

3.2 Augue sapien mattis leo

Nec accumsan turpis quam at neque. Ut pellentesque velit sed placerat cursus. Integer congue urna non massa dictum, a pellentesque arcu accumsan. Nulla posuere, elit accumsan eleifend elementum, ipsum massa tristique metus, in ornare neque nisl sed odio. Nullam eget elementum nisi. Duis a consectetur erat, sit amet malesuada sapien. Aliquam nec sapien et leo sagittis porttitor at ut lacus. Vivamus vulputate elit vitae libero condimentum dictum. Nulla facilisi. Quisque non nibh et massa ullamcorper iaculis. A random citation to demonstrate the bibliography; [1]

CHAPTER 4
EXAMPLES OF EDITOR/AUTHOR TOOLS, TABLES, AND IMAGES

4.1 Example of using the authorRemark and editorRemark

If you don't see any blue or red type under this line, then you almost certainly need to include the optional "editMode" to the document class. Thus your document class (first line) should read `\documentclass[editMode]{ufdissertation}`.

Test! This is a remark written by the author, to themselves, for review purposes. It will be suppressed unless editMode is used in the class options.

This is an editor's remark, written by an editor in-line so that they can write into the content itself with something easy to see. But the remark will be suppressed unless editMode is used in the class options.

To get this remark to go away, simply remove "editMode" from the documentclass options at the top of the user's tex-file. This also removes the blue Author Remarks.

4.2 Table Examples

You may notice that some tables get moved outside of where you placed them. This is because LaTeX is a little too helpful when it comes to placement of 'float' types; which includes tables and figures. You can get around this by using the "H" parameter in the table environment, or the 'multiFigure' environment described in the "adding graphics section"; ie section 4.4

Some	Data	Goes	Here
Some	Data	Goes	Here
Some	Data	Goes	Here
Some	Data	Goes	Here

Table 4-1. This table is located in the correct section because it uses the "H" optional parameter in the table environment, unlike the next tables which have been helpfully moved by LaTeX to the next page, which places them inside the section.
You should also make a note that the caption command is placed after the table itself, which means the caption occurs after the table. The graduate school requires tables to have captions placed before the actual table data, so the caption command should be located before the table data. See the next table for an example.

4.3 Very Long Tables

There are two approaches to inputting very long tables. You can do it manually, or you can do it using the longtables package. Here we include an example of both. Table 4-3 is done manually, whereas 4-4 is done using the longtables package.

Table 4-2. Notice that this caption is included above the table data, as per the graduate school requirements. Also note that the caption itself has a short version in the "List of Tables" which is achieved by using the optional argument of the caption command. See the file source code directly to see the example.
Unfortunately, since we did not use the "H" parameter in the table environment, this table was placed *after* the next section heading, which is almost certainly not where an author would have wanted it.

Some	Data	Goes	Here
Some	Data	Goes	Here
Some	Data	Goes	Here
Some	Data	Goes	Here

Table 4-3. Feasible triples for highly variable Grid, MLMMH.

Time (s)	Triple chosen	Other feasible triples
0	(1, 11, 13725)	(1, 12, 10980), (1, 13, 8235), (2, 2, 0), (3, 1, 0)
2745	(1, 12, 10980)	(1, 13, 8235), (2, 2, 0), (2, 3, 0), (3, 1, 0)
5490	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
8235	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
10980	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
13725	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
16470	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
19215	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
21960	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
24705	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
27450	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
30195	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
32940	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
35685	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
38430	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
41175	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
43920	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
46665	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
49410	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
52155	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
54900	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
57645	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
60390	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
63135	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
65880	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
68625	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
71370	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
74115	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
76860	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
79605	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
82350	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)

Table 4-3. Continued

Time (s)	Triple chosen	Other feasible triples
85095	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
87840	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
90585	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
93330	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
96075	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
98820	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
101565	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
104310	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
107055	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
109800	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
112545	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
115290	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
118035	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
120780	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
123525	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
126270	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
129015	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
131760	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
134505	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
137250	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
139995	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
142740	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
145485	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
148230	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
150975	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
153720	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
156465	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
159210	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
161955	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
164700	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)

Alternatively, compared to the previous example where we used manual breaks to break the table, we can let LaTeX do this for us, as well as taking care of any recurrent headers and footers, utilizing the `\longtable` command,[1] as follows:

Table 4-4. Duplicate of Previous table, using longtables environment.

Time (s)	Triple chosen	Other feasible triples
0	(1, 11, 13725)	(1, 12, 10980), (1, 13, 8235), (2, 2, 0), (3, 1, 0)
2745	(1, 12, 10980)	(1, 13, 8235), (2, 2, 0), (2, 3, 0), (3, 1, 0)
5490	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
8235	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
10980	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
13725	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
16470	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
19215	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
21960	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
24705	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
27450	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
30195	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
32940	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
35685	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
38430	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
41175	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
43920	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
46665	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
49410	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
52155	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
54900	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
57645	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
60390	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
63135	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
65880	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
68625	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
71370	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
74115	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
76860	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
79605	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
82350	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
85095	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
87840	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
90585	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
93330	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)

[1] note that the longtable environment is not in a table environment; putting it inside a table environment will stop it from correctly page breaking as needed.

continued

Time (s)	Triple chosen	Other feasible triples
96075	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
98820	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
101565	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
104310	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
107055	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
109800	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
112545	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
115290	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
118035	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
120780	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
123525	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
126270	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
129015	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
131760	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
134505	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
137250	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
139995	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
142740	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
145485	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
148230	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
150975	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
153720	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)

continued

Time (s)	Triple chosen	Other feasible triples
156465	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
159210	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
161955	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
164700	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)

4.4 Examples of Adding Graphics

All of the below code with subfigures A-Z was generated with:

```
\begin{multiFigure}
\addFigure{0.3}{./theworld.png}
\addFigure{0.2}{./theworld.png}
\addFigure{0.4}{./theworld.png}
\addFigure[Z]{0.6}{./theworld.png}
\captionof{figure}[This is a test caption.]{This is a test caption.
This text has the bit for the whole figure.
Meanwhile, subfigure A is weird looking map.
Subfigure B is a smaller map.
And Subfigure C is a bigger but still weird looking map.
Moreover, I can override the map, which is why Z is
another weird map that came after map C.}
\end{multiFigure}
```

Note that LaTeX can be pretty fickle when it comes to placing figures relative to text near the figure. Specifically, the "Figure" environment is a 'float' type, which is placed somewhere "nearby" where it appears in the text, which can be pretty frustrating. For this reason I have circumvented the 'float' part of the figure in order to allow more control over the figure placement. So if one uses the `\begin{figure}\end{figure}` construction, the figure may appear in a slightly weird place, whereas you can use the `\begin{multiFigure}\end{multiFigure}` even with only 1 figure, to force placement to work. The only caveat here is that captions need to be

placed using the command `\captionof{<NAME>}[<LIST-ENTRY>]{<CAPTION>}` where NAME is the type of caption, LIST-ENTRY is what appears in the 'List of' at the beginning of the thesis, and CAPTION is the actual caption.

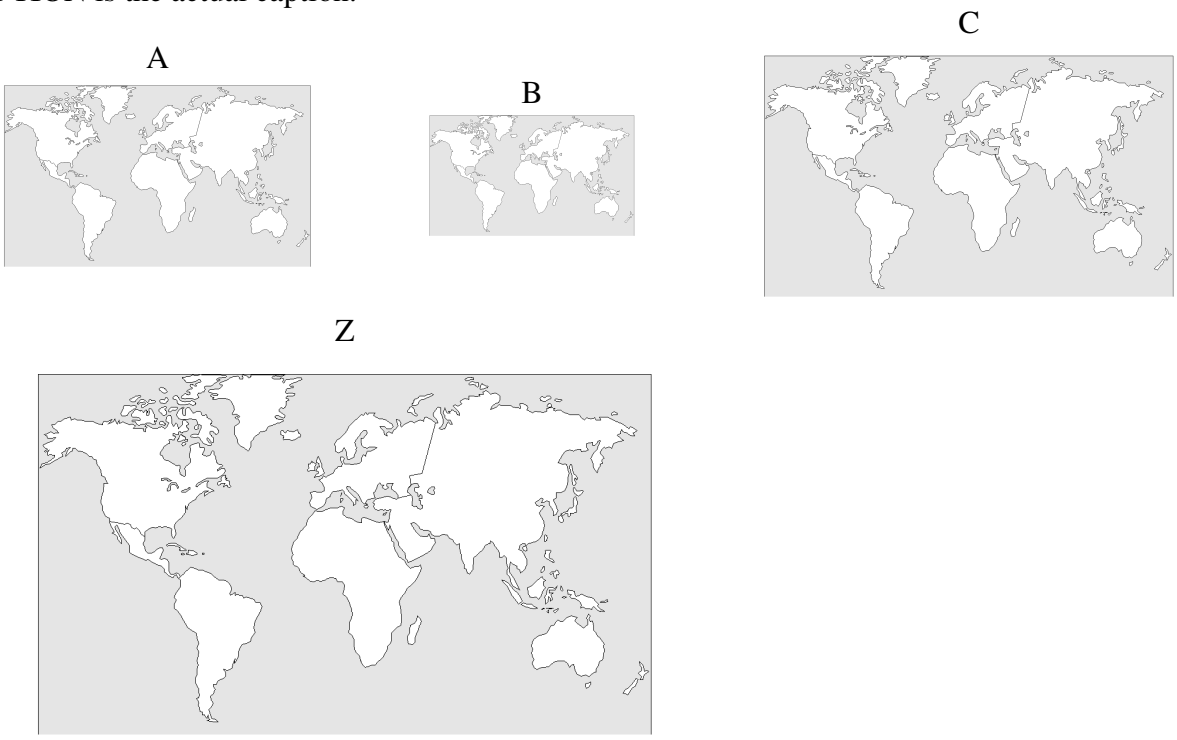

Figure 4-1. This is a test caption. This text has the bit for the whole figure. Meanwhile, subfigure A is weird looking map. Subfigure B is a smaller map. And Subfigure C is a bigger but still weird looking map. Moreover, I can override the map, which is why Z is another weird map that came after map C.

Figure 4-2. This is a super-long caption to make sure that the caption in the list-of section is correctly single space with the blank white line between captions. That being said, you should probably always use the list-entry optional argument in the captionof command to write a shorter caption instead of this nonsense.

4.5 A Note On Graphics

The command `\addFigure` in the multiFigure environment, and/or the command `\includegraphics` will take almost every type of graphic file currently in use as of the writing of this template. The only notable exception is the bitmap, ie .bmp file. Most software won't save to bitmap without specifically requesting it at this point, but if you have generated a .bmp file you can load it in most any graphic editor (eg MSpaint or photoshop) and save it as a different file type, such as .PNG which is significantly smaller file size as well. Note that the commands typically require the file extension to be included, and it is case sensitive. Thus in the above `\addFigure{0.2}{./theworld.png}` works but `\addFigure{0.2}{./theworld.PNG}` would error and `\addFigure{0.2}{./theworld}` may or may not work depending on which specific TeX editor you are using.

CHAPTER 5
SUMMARY AND CONCLUSIONS

5.1 Non Porttitor Tellus

Aliquam molestie sed urna quis convallis. Aenean nibh eros, aliquam non eros in, tempus lacinia justo. In magna sapien, blandit a faucibus ac, scelerisque nec purus. Praesent fermentum felis nec massa interdum, vel dapibus mi luctus. Cras id fringilla mauris. Ut molestie eros mi, ut hendrerit nulla tempor et. Pellentesque tortor quam, mattis a scelerisque nec, euismod et odio. Mauris rhoncus metus sit amet risus mattis, eu mattis sem interdum.

5.1.1 Nam Arcu Magna

Semper vel lorem eu, venenatis ultrices est. Nam aliquet ut erat ac scelerisque. Maecenas ut molestie mi. Phasellus ipsum magna, sollicitudin eu ipsum quis, imperdiet cursus turpis. Etiam pretium enim a fermentum accumsan. Morbi vel vehicula enim.

5.1.1.1 Ut pellentesque velit sede

Placerat cursus. Integer congue urna non massa dictum, a pellentesque arcu accumsan. Nulla posuere, elit accumsan eleifend elementum, ipsum massa tristique metus, in ornare neque nisl sed odio. Nullam eget elementum nisi. Duis a consectetur erat, sit amet malesuada sapien. Aliquam nec sapien et leo sagittis porttitor at ut lacus. Vivamus vulputate elit vitae libero condimentum dictum. Nulla facilisi. Quisque non nibh et massa ullamcorper iaculis.

APPENDIX
SOME ADDITIONAL MATERIAL

Test for first appendix file.

Table A-1. A sample Table using tabularx

First	Second	Third
12	45	26
17	32	93
text	51	can be there too.

Figure A-1. This is a super-long caption to make sure that the caption in the list-of section is correctly single space with the blank white line between captions. That being said, you should probably always use the list-entry optional argument in the captionof command to write a shorter caption instead of this nonsense.

Test for second appendix file.

Test for third appendix file.

BIOGRAPHICAL SKETCH

This is the "biographical sketch" tex file, which should have been set in the main file using the command `\setBiographicalFile{Drive:/file/location/biographyFile}`.

Keep in mind this should be written in **third person** and should assume you have already completed your degree that you are writing this thesis or dissertation for. For example:

Jason is a person that wrote some code, did some research, and eventually got a PhD in mathematics for some stuff. He had to actually write a real biographical sketch because he had forgotten to do it until final submission.