From Simple B-Spline to GERBS Surface, or How I Stopped Sleeping and Learned to Hate My Life

D. A. Salwerowicz

UiT - The Arctic University of Norway, P.O. Box 385, N-8505 Narvik, Norway

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Abstract

`//TODO`

Keywords: Parametric Curves; B-Splines; Curve Blending; GERBS

1 Introduction

This project revolves around implementing various geometric objects using GMlib as a basis. Each of these object builds on previous therefore I will describe them seperately. Main focus of this project was to implement a GERBS curve and use affine transformations to create a dynamic animation.

1.1 B-Spline curve

Most basic object that I have implemented is a third degree, fourth order B-Spline curve using both a vector of *control points* and *sampling*.

1.2 Blending curve

A more advances object implemented by me is a blending curve that takes in two curves and blends them into one curve using any percent of the original curves it wants. So I can use 50% or 75% of these curves and blend the rest.

1.3 GERBS curves and surfaces

Last and most complex objects implemented are a GERBS curve and surface, where GERBS stands for *Generalized Expo-Rational B-Spline.* These objects are build out of local curves and surfaces that are blended together to form a curve/surface, instead of simple control points.

2 Material & Methods

2.1 About the material & methods part

The presentation of the material and methods used in the actual work/analysis should be sufficient to be evaluated or reproduced. Methods or parts of methods that have already been published should be indicated by a reference. Do not include unnecessary details about commonly known or standardized methods that can be referred to. Limit the description to additional or unique applications and relevant modifications. Unlike the Abstract and the Introduction, the Material and methods part may be differently named and may also be a section of several chapters. Examples of commonly used chapters for this part are: Theory Modelling, Experimental apparatus and procedure, Experimental setup etc.

2.2 About subdivision - numbered sections

Subsections are to be numbered 1.1, 1.2, 1.3 etc. The report/article is limited in size so there is no need for further numbered subdivision into 1.1.1 etc. This numbering should also be used in the internal crossreferencing. Equations are numbered continuously by integer number regardless of sub chapters, and arranged as shown in the example below. Transport of drifting snow by suspension is modelled so that suspension approaches asymptotically a saturated transport rate given by:

$$q_{suspension} = \frac{u(1)^{4.13}}{853119} \tag{1}$$

where u(10) is the air velocity at the height of 10m (D. Tabler et al., 1990).

Figures and tables are also numbered continuously, with text sizes and appearances as shown in the examples below.

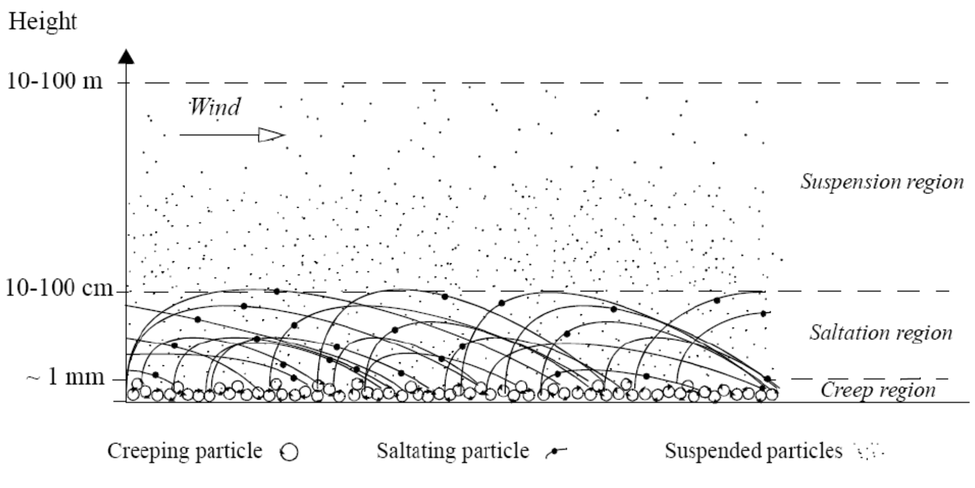

Figure 1. Illustration of the drifting snow transport regions above a horizontal snow surface. The transport regions are illustrated by the typical snow particle movements/behaviour (Sundsbø, 1997).

Part in article structure	About function & requirements
Abstract	Briefly states the purpose of the analysis/work principal results and eventually major conclusions. Should be enabled to be presented separately (fast track searches).
1. Introduction	The introduction should state the objectives of the analysis/work and give the reader an adequate background. Possible include why and where was the study undertaken.
2. Material & Methods	Represents important documentation related to the work. Description & references should be sufficient to evaluate or reproduced the work/analysis.
3. Results & Discussion	This is normally the main section of the paper/report and results should be clear and concise. Limit the presentation of results to what is necessary for further discussion and conclusions.
4. Conclusions	The results & discussions forms the basis for the main conclusion(s) and any conclusion must be presented as clear and concise as possible.
Acknowledgements	As brief as possible.
References	Check proper formatting and citations versus reference list.
Appendices	Supplementary part, considered to be a necessity for the main target group of readers.

Table 1. Basic structure for reporting in the actual course.

2.3 Figure captions

Ensure that each illustration has a caption that includes a brief title and description of the actual illustration. Text can also be included in the illustrations, e.g. on a photo, graph etc. Text in the text is useful for explaining symbols and abbreviations used. The caption text should be kept to a minimum. However, as a thumb rule the figure with caption should be sufficient to understand the figure/illustration without reading the surrounding body text.

2.4 About References

Use the suggested citation style which includes Author family name(s) and year of publication, hence (Author family name(s), year of publication). The reference list must then be arranged correspondingly according to family names of the corresponding or first author and year. In this way the reader does not necessary have to look back in the reference list to check the origin of the actual information or theory. Any citation in the text must refer to a reference in the reference list and visa versa. Example:

Citation in the text:	(Sundsbø and Bang, 1998)
Corresponding reference in Reference list:	Sundsbø, P.-A. and Bang, B. (1998). International Snow Science Workshop, page 279–283.

For Web references, please use author/organization names, dates, reference to a source publication, etc., if available. This together with a full URL (Uniform Resource Locator). As a minimum, the full URL must be given. Web references can be included in the reference list or be listed separately after the reference list.

Citation in the text:	(Flow Science Inc, 2010)
Corresponding reference in Reference list:	Flow Science Inc (2010). Flow 3d. http://www.flow3d.com/apps/index.html. Accesed on 2010-10-21.
Citation in the text:	(SINTEF, 2010)
Corresponding reference in Reference list:	SINTEF (2010). The centre for renewable energy. http://www.sintef.no/Home/Environment/fornybar-energi. Accesed on 2010-10-25.
Several citations from the same source:	(SINTEF, 2010, a), using a, b, c etc.
Several references on one citation:	((SINTEF, 2010); (Flow Science Inc, 2010))

2.5 About the Appendices

Appendices are to be located in the end of the document since this is considered as a supplementary part, however considered to be a necessity for the main target group of readers. If there is more than one appendix, they should be numbered as A, B, etc. Further numbering in the appendices must be related to the given appendix (equation (1), table 1, figure 1, etc.).

Source code may be located in the appendices or attached in digital format. Any programming parts that might be considered as real goodies may be located in the results section of the report. However, this depends highly on the nature of the project. In general, limit the attached data material to what is considered to be a necessity for the main target group for the particular work. Any attached digital video formats must be compatible with commonly used software.

2.6 Reporting from a reading course, review of an engineering topic or State of the Art

Engineers and researchers do regularly encounter problems or challenges that require an in depth study to gain more knowledge and understanding about a specific type of problem or solution methods. For a researcher this normally means reading articles describing the latest, related research results. Often this means investigating state of the art of the research area for a given topic. Writing of typical State of the art research articles normally requires a certain amount of international level research experience. An engineer must sometimes gather information to prepare for or to enable engineering solutions or analysis. This preparation may be for himself, for co-workers or to establish a decision background for costs/resources related to processes.

An engineering student must always keep in mind the very purpose of doing such an investigation. Main objectives must always be clear and that must be reflected in the reporting. Students often ask themselves (and others) what to write in the conclusions. “We have been collecting a lot of material on the actual topic and arranged the results in a logical structure...., so what?’ Well, this is normally a result of the commonly used cut-and-paste-from-literature / Web-without-thinking-method. Please pay special attention to possible conclusions already from the start of the actual work or analyses. In typical method investigations or in dept studies it is especially important always to maintain the awareness regarding the main objectives for doing the work. A good advice is regularly to look for possible solutions or conclusions to your questions.

3 Results & Discussion

This is normally the main section of the paper/report and results should be clear and concise. Limit the presentation of results to what is necessary for further discussion and conclusions. Remaining material may alternatively be presented in the Appendices. For consultancy analysis the results must be sufficient to fulfil the task requirements and providing a solution to the problem/mission.

The discussion should supplement the results by explaining, evaluating and exploring the significance of the results of the work/analysis. **It is not necessary to repeat or recreate all what we clearly should have seen from the results (illustrations, pictures, tables, graphs etc.)**. Illustrations with belonging text info should be self-explanatory. The discussions may be included in the Results part however the discussion may also be presented separately after.

4 Conclusions

The results and discussions forms the basis for the main conclusion(s) and any conclusion must be presented as clear and concise as possible. The conclusions are normally presented in a separate short Conclusions section (as in this description). However, Conclusions may be a subsection of a Discussion or Results and Discussion section.

The conclusions in an average student work/project are normally weak and often the weakest point of the report. Please pay special attention to possible conclusions already from the start of the actual work or analyses. By always keeping an awareness regarding the main objectives for doing the work or making the analysis, the conclusions regarding whether you have achieved your goals or not, becomes clear.

As a student and later working with engineering analysis, research etc., always keep in mind that structuring your reporting also will increase the efficiency of the work itself and thereby improving your results.

Suggestions and recommendations for further work or analysis should be located in or immediately after the conclusions section. This since reflections about the further work naturally is the 'final' words from the author(s) to the reader and that these recommendations are normally founded on the conclusions.

5 Acknowledgements

The author would like to thank his colleagues at the postgraduate studies at UiT The arctic university of Norway in Narvik for reading and commenting on this document (Providing language help, writing assistance or proof reading the article, etc.).

6 References

D. Tabler, R., Pomeroy, J., and Santana, B. (1990). *Drifting snow*, pages 95–145. American Society of Civil Engineers.

Flow Science Inc (2010). Flow 3d. `http://www.flow3d.com/apps/index.html`. Accesed on 2010-10-21.

SINTEF (2010). The centre for renewable energy. `http://www.sintef.no/Home/Environment/fornybar-energi`. Accesed on 2010-10-25.

Sundsbø, P.-A. (1997). *Numerical modelling and simulation of snow drift: application to snow engineering*. PhD thesis. ISBN 82-471-0047-9.

Sundsbø, P.-A. and Bang, B. (1998). *International Snow Science Workshop*, page 279–283.

A Appendix A. Example on research paper and consultancy report structure

- An appropriate structure on your reporting will often improve the structure of the actual work/analysis and thereby improving the final results.
- Most students/engineers develop a certain structure on a specific type work even if they think they do not.

The structure chosen for the reporting in this course consists of the following parts: Abstract, Introduction, Material & Methods, Results & Discussion, Conclusion, Acknowledgements, References and Appendices, reflects the basic within various types of scientific and engineering reporting.

A.1 Example on a research paper structure for publication in an international engineering journal:

Beyers, J.H.M., Sundsbø, P.A. and Harms, T.M., 2004, Numerical simulation of three-dimensional, transient snow drifting around a cube, Journal of Wind Engineering and Industrial Aerodynamics, Volume 92, 725-747.

- Abstract
- Nomenclature
- 1. Introduction
- 2. Numerical modelling (Material and Methods)
- 3. Experimental results (Results/Discussion)
- 4. Numerical results and discussion (Results/Discussion)
- 5. Conclusion
- Acknowledgements
- References

A.2 Example on a consultancy report structure (large report, several issues):

Sundsbø, P.A., 2004, Wind Chill Index- and snowdrift simulations/analysis on Hammerfest LNG Plant, WSB report 105-03 Rev 1, Commissioned by Tractebel Industry Engineering, Brussels.

- Summary (Abstract)
- 1.0 Introduction
- 2.0 The Wind Chill Index (WCI) (Material and Methods)
- 3.0 Meteorological data – WCI (Material and Methods)
- 4.0 Snow drift conditions (Material and Methods)
- 5.0 Numerical model (Material and Methods)
- 6.0 Numerical simulations of WCI (Results/Discussion)

- 7.0 Numerical simulations of snowdrift (Results/Discussion)
- 8.0 Snow drift control (Results/Discussion)
- 9.0 Emergency escape ladder location (additional separate analysis)
- 10.0 Conclusions
- References
- Appendices (I-III, showing results from WCI & snowdrift analysis)

Comments: Material related to modelling, programming, simulations and data collections may be presented in the Appendices. Do not include unnecessary data/info. Evaluate this carefully.

A Appendix B. Example on heading section for student project report

Natural ventilation in an Inuit snow igloo (SMN6200)

Andreas Cruickshank (480214)

UiT The arctic university of Norway in Narvik, PO Box 385, N-8505 Narvik

Submitted 16 December 2016

Abstract

This report details the simulation of temperature- and wind-flow in and around an Inuit snow igloo, simulating the natural ventilation in an igloo. The test simulation was set up and run in Flow-3D, and the visualization of the corresponding data was done in a custom created ray casting volume rendering program.

The visualization gives a better understanding of the resulting dataset produced by the numerical fluid solver. The visualization program uses a relatively new and high tech technique called ray casting for rendering the simulation results. This technique utilises the Graphics Processing Unit (GPU), which makes the visualization run very quick and smooth. Most importantly we can easily understand and interpret the simulated results. We can observe the main natural ventilation effects in an igloo represented by wind pressure- and thermal buoyancy driven effects.

Keywords: CFD; Numerical simulation; Natural ventilation Flow3D

1. Introduction

This report covers a simulation on the natural ventilation in an Inuit snow igloo. Natural ventilation is the concept of supplying the indoor environment with fresh air and removing "old" simply by natural means. Not using mechanical effects leaves us with what we can obtain from heat gradients and the surround winds. Due to excellent insulating properties of snow and a superbly heat conserving design, inhabited igloos are surprisingly warm inside. The igloo's design also reduces conduction and convection heat transfer from the igloo's envelope surface. The igloo's thermal performance could provide a temperature differential, indoor to outdoor, of 40ºC. The entrance region normally consisted of several multipurpose rooms with storage and sheltering functions, buffer zones between the indoor living module and outdoor conditions. For structure reasons, the mean radiant temperature of the ice surface needs to be kept near-freezing (Sundsbø, 2011).