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October 20??

Thesis submitted for the degree of Honours in ?????

SCHOOL OF MATHEMATICAL SCIENCES

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Declaration

Except where stated this thesis is, to the best of my knowledge, my own work and my supervisor has approved its submission.

Signed by student:

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Acknowledgements

Abstract

Abstract

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Chapter 1

Introduction

1.1 Theory

Definition 1.1.1. Stream Function

Definition 1.1.2. Vorticity

Definition 1.1.3. Circulation

Theorem 1.1.4.

Lemma 1.1.5. 1.1.1 Finite Differences

First order:

Backward difference:

$$f'(x) = \frac{f(x) - f(x-h)}{h} + \mathcal{O}(h)$$

Forward Difference

$$f'(x) = \frac{f(x+h) - f(x)}{h} + \mathcal{O}(h)$$

Central Differences

$$f'(x) = \frac{f(x+h) - f(x-h)}{2h} + \mathcal{O}(h^2)$$

Backwards differences for a second derivative

$$f''(x) = \frac{f(x) - 2f(x-h) + f(x-2h)}{h^2}$$

Forwards

$$f''(x) = \frac{f(x+2h) - 2f(x+h) + f(x)}{h^2}$$

Central

$$f''(x) = \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$$

Chapter 2

The Squire-Long model

2.1 Vorticity form

Azimuthal vorticity, η.

Chapter 3

Flow Examples

3.1 Rotating Flow

3.2 Rankine Vortex

3.3 Lamb-Oseen Vortex (Possibly Bachelor Vortex?)

Chapter 4

Solver

4.1 Computational Efficiency?

Appendices

Appendix A

Derivation of Squire-Long

Appendix B

Conclusion

Appendix C

Code

C.1 Code1

Bibliography