

# Contents

Chapter 1. Introduction	1
1.1. Outline	5
Acknowledgment	6
Chapter 2. Contour dynamics formulation	7
2.1. Complex notation and vector notation	7
2.2. Parametrization	7
2.3. Evolution System	9
2.4. Calculations Involving the Fourier Transform	11
2.5. Linearization and Nonlinear Expansion	11
Chapter 3. Notation and main results	21
3.1. Notation	21
3.2. Main Results	22
Chapter 4. Implicit function theorem	25
4.1. Calculation of the Fréchet derivatives	26
4.2. Proof of the Implicit function theorem	27
Chapter 5. Fourier multiplier estimates	35
5.1. Estimates on the operator $\mathcal{R}$	36
5.2. Estimates on the non-linear operator $\mathcal{S}$	38
Chapter 6. <i>A priori</i> estimates on the vorticity strength	47
Chapter 7. Global existence and instant analyticity	53
7.1. Estimate for $L(t)$	53
7.2. <i>A priori</i> Estimates for $\theta(t)$	54
7.3. Nonlinear Estimates in $\dot{\mathcal{F}}_v^{s,1}$	66
7.4. Regularization scheme and completion of the proof of Theorem 3.1	71
Chapter 8. Uniqueness	73
8.1. Estimates for the differences of the lengths	75
8.2. Estimates for the differences of the vorticity strength	76
8.3. Estimates for the differences of the main nonlinear term	81
8.4. Proof of uniqueness	84
Bibliography	85