

Contents

Acknowledgments	v
Table of Contents	vii
List of Figures	ix
Introduction	1
1 Model for bacterial flagellar filaments	9
1.1 Introduction	9
1.2 Summary of previous work	12
1.2.1 Experiments	12
1.2.2 Models	15
1.3 A new model - Introduction	20
1.4 Filament elastic energy	20
2 Simplified Model for Polymorphism of Filaments - Response to external moment and force	34
2.1 Introduction	34

2.2	Ground states	35
2.3	Response to external moment	40
2.4	Response to external force	54
3	Full Model for Polymorphism - Response to external moment and force	59
3.1	Introduction	59
3.2	Ground states	60
3.3	Response to moment and force	63
3.4	Discussion and conclusion	67
4	Dynamics of a bistable rod in a fluid flow - without interfacial energy penalty	71
4.1	Introduction	71
4.2	Problem Formulation	78
4.2.1	Van der Waals Equation	78
4.2.2	Governing Equation	84
4.2.3	Bilinear material	89
4.2.4	Trilinear material	92
4.2.5	Nonlinear material	94
4.3	No interfacial energy term in strain energy density	95
4.3.1	Bilinear material	97
4.3.2	Trilinear material	111
4.3.3	Nonlinear material	115

5 Dynamics of a bistable rod in a fluid flow - with interfacial energy penalty	121
5.1 Inclusion of interfacial energy penalty	121
5.1.1 Bilinear material	122
5.1.2 Trilinear material	137
5.1.3 Nonlinear material	139
5.2 Discussion and Conclusions	145
A Euler angles	150
B Finite Element Formulation for Nonlinear Materials	153
Bibliography	160