

Contents

List of Figures	vii
Preface	xi
1. Introduction	1
2. Homoclinic Tangles and Transport in Two-Dimensional, Time-Periodic Vector Fields	7
2.1 Introduction	7
2.2 Melnikov's Method for Time-Periodically Forced One Degree-of-Freedom Hamiltonian Systems	7
2.3 Dynamics in Homoclinic Tangles	12
3. Transport in Cellular Flows	19
4. Homoclinic Tangles and Transport in Two-Dimensional, Time-Quasiperiodic Vector Fields	29
4.1 Introduction	29
4.2 Melnikov's Method for Two-Dimensional Quasiperiodically Time-Dependent Vector Fields	29
4.3 The Geometry of Manifold Intersections	33
4.4 Lobes and Flux	35
5. Phase Space Transport in the Quasiperiodically Forced Morse Oscillator	47
5.1 Introduction	47
5.2 The Morse Oscillator	47
5.3 Set-Up of the Transport Problem	50
5.4 Fluxes and Dissociation rates	52
6. Adiabatic Dynamical Systems	57
7. Transport in the Eccentric Journal Bearing Flow: An Application of Adiabatic Dynamical Systems	63
7.1 Introduction	63
7.2 The Eccentric Journal Bearing Flow	63

7.3	Transport Analysis–Lobe Geometry and Dynamics	69
7.4	Analytical Estimates from Adiabatic Dynamical Systems Theory . .	78
8.	Orbits Homoclinic to Resonances: Global Analysis and Geometric Singular Perturbation Methods	81
8.1	The Basic Perturbed, Two-Degree-of-Freedom Integrable Hamiltonian System	81
8.2	The Analytic and Geometric Structure of the Unperturbed Equations	82
8.2.1	The Dynamics of the Unperturbed System Restricted to \mathcal{M} .	83
8.2.2	The Dynamics in Γ and its Relation to the Dynamics in \mathcal{M} .	83
8.3	The Analytic and Geometric Structure of the Perturbed Equations .	84
8.3.1	The Persistence of \mathcal{M} and its Stable and Unstable Manifolds	84
8.3.2	The Dynamics on \mathcal{M}_ϵ near the Resonance	88
8.3.3	The Fiberings of $W^s(\mathcal{A}_\epsilon)$ and $W^u(\mathcal{A}_\epsilon)$: The Singular Perturbation Nature	98
8.4	Melnikov’s Method for Detecting Orbits Homoclinic and Heteroclinic to Invariant Sets in \mathcal{A}_ϵ	103
8.5	An Example: Dynamics of a Modal Truncation of the Nonlinear Schrödinger Equation	126
8.5.1	The Unperturbed Structure	129
8.5.2	The Perturbed Structure	133
8.5.3	Orbits Homoclinic to p_ϵ : Non-Hamiltonian Perturbations . .	140
8.5.4	Orbits Homoclinic to q_ϵ : Non-Hamiltonian Perturbations . .	141
8.5.5	Orbits Homoclinic to Internal Orbits: Hamiltonian Perturbations	143
	References	147
	Index	153