

Contents

1	Motion of Charged Particles in a Line	1
1.1	The Equation with Attractive Singularity	2
1.1.1	Existence Results	2
1.1.2	Global Dynamics	3
1.1.3	Bouncing Solutions	5
1.2	The Equation with Repulsive Singularity	7
1.2.1	Existence Results	7
1.2.2	Uniqueness and Stability Results	8
1.2.3	Abundance of Subharmonic Solutions	10
1.2.4	Motion of a Piston Inside a Cylinder	10
1.3	Further Remarks and Open Problems	12
	References	13
2	An Electrostatically Actuated Micro-electro-mechanical System	15
2.1	A Non-autonomous Saddle-Node Bifurcation	17
2.2	Further Remarks and Open Problems	18
	References	19
3	Forced Keplerian-Like Systems	21
3.1	Gravitational and Electrostatic Interactions	21
3.2	Intermolecular Forces, Lennard-Jones Potential	24
3.3	Final Remarks and Open Problems	26
	References	26
4	Particles Under a Central Force Field	29
4.1	A General Result	30
4.2	Periodic Motions Around Pulsating Stars	31
4.3	Radial Stability of the Gylden Model	35
4.4	A Relativistic Oscillator	36

4.5	Periodic Motion of a Neutral Atom Near a Charged Wire	37
4.6	Further Remarks and Open Problems.	40
	References.	40
5	Bose-Einstein Condensates and Signal Transmission in Optical Fibers	43
5.1	Modulated Amplitude Waves in Quasi-1D BECs	44
5.1.1	Attractive Interaction.	45
5.1.2	Repulsive Interaction.	46
5.1.3	Attractive-Repulsive Interaction	46
5.2	Parametric Resonance of a Two-Dimensional BEC with Time-Periodic Trapping	48
5.3	Trapless Stabilization of BEC Solitons.	50
5.4	A Model for Nonlinear Pulse Propagation in Optical Fibers . . .	52
5.5	Further Remarks and Open Problems.	56
	References.	57
6	Electron Beam Focusing by Means of a Periodic Magnetic Field	59
6.1	Shielded Cathode	61
6.2	Unshielded Cathode	64
6.3	Further Remarks and Open Problems.	65
	References.	67
7	Point Vortex Dynamics	69
7.1	Passive Particle Transport in a Vortex Flow	69
7.1.1	Chaotic Advection Under a Blinking Protocol	71
7.1.2	Periodic Motions of Fluid Particles Under a Smooth Stirring Protocol	73
7.2	Vortex Interaction in a Time-Periodic Deformation Flow	75
7.2.1	Dynamics of a Corotating Vortex Pair in a Pulsating Trap	76
7.2.2	Dynamics of a Dipole in a Pulsating Trap	78
7.3	Further Remarks and Open Problems.	81
	References.	82
8	Pumping Effect in a Pipe/Tank Flow Configuration	85
8.1	The Model.	85
8.2	Existence Results	87
8.3	A Stability Result	90
	References.	91

9	Radial Oscillations of a Bubble in a Time-Periodic Pressure Field	93
9.1	The Model.	93
9.2	Vapor Bubbles	95
9.3	The Effect of Gas Pressure.	97
	References.	98
10	Radial Oscillations of Cylindrical and Spherical Shells	99
10.1	Radial Oscillations of a Hollow Sphere	99
10.2	Radial Oscillations of a Cylindrical Tube	103
10.3	Further Remarks and Open Problems.	104
	References.	105
11	A Model for Cell Volume Regulation	107
	References.	111
	Appendix A: Mathematical Toolbox	113
	Index	123

Mathematical Models with Singularities

A Zoo of Singular Creatures

Torres, P.J.

2015, XIII, 124 p. 16 illus., 7 illus. in color., Softcover

ISBN: 978-94-6239-105-5

A product of Atlantis Press