

Index

- abelian integral, 229, 237, 269, 382
- adjoint operator, 55, 94, 99, 100, 114, 134, 154, 165
 - method, 54, 134
- A-normal form, 53, 54, 57, 58, 60, 64, 65, 67, 68, 69, 188
 - of equation with periodic coefficients, 92
 - of equation with symmetry, 108, 109, 113
 - general form of, 53
 - of map near fixed point, 99, 101, 102, 147
 - of the real equation, 68–70, 95–7, 111–13
- asymptotical stability, 45–7
 - of homoclinic loop, 215
- bifurcation, 1, 3, 27, 31, 191, 194, 196, 200, 229, 330, 334, 338, 339, 342
 - Bogdanov–Takens, 413, 446, 448
 - codimension of, 191–2, 196
 - codimension one, 191, 226, 446
 - codimension two, 228, 229, 446
 - codimension three, 409, 446, 450
 - cusp type of, 232, 409, 430, 450
 - degenerate Hopf, 227, 383–90, 392–3, 417, 426, 431
 - degenerate Homoclinic, 227, 413, 417, 426, 431
 - diagram, 200, 228, 231, 252, 259, 260, 261, 278, 291, 298, 299, 331, 337, 338, 342, 355, 360, 361, 362, 369, 414, 425, 426, 428, 446
 - double limit cycle, 273, 275, 412, 418, 421, 426, 434, *see also* limit cycle
 - function, 256, 318, 344, 352, 371, 375, 407, 418
 - heteroclinic, 338, 350, 379, 451
 - higher codimension, 383, 450
 - homoclinic(loop), 213, 227, 241, 246, 273, 393, 400, 408–9, 412, 413, 416, 417, 418, 426, 428–30, 431, 441, 448, 449, 450, 451
 - Hopf, 177, 197, 203, 204, 208, 209–12, 229, 231, 233, 265, 283, 294, 296, 304, 329, 330, 338, 342, 360, 361, 369, 379, 383, 392, 412, 413, 416, 417, 418, 426, 428–30, 431, 448, 449, 450 *see also* bifurcation, degenerate Hopf
 - of equilibrium, 197–213, 339
 - pitchfork, 177, 201, 337, 342
 - point, 191–2
 - saddle-node, 177, 197, 231–3, 330–1, 337, 342, 360, 369, 412, 430, 446
 - set, 191
 - transcritical, 177, 201
 - triple limit cycle, 434, 437, *see also* limit cycle
- Bogdanov–Taken system, 229, 413, 428, 448
- Cauchy’s inequality, 74, 84
- center manifold, 1, 44, 47, 48, 228
 - global, 2, 4, 12, 27, 29, 31, 32, 33, 34, 35, 44, 45
 - local, 2, 3, 27, 29, 30, 31, 32, 33, 34, 44, 45
 - smoothness of, 12
 - stability, 44
- center-stable manifold, 3, 44
 - global, 35
 - local, 47
- center-unstable manifold, 3, 35, 36, 44
 - global, 35
 - local, 47
- centralizer, 151, 165
- codimension
 - of bifurcation, 191–2, 196, 197, 226, 228, 229, 383
 - of submanifold, 194, 198, 253
- continuous inclusion, 13, 39
- cut-off function, 3, 27, 29, 32
- cut-off technique, 2, 27, 35

Cambridge University Press

978-0-521-37226-8 - Normal Forms and Bifurcation of Planar Vector Fields

Shui-Nee Chow, Chengzhi Li and Duo Wang

Index

[More information](#)

470

deformation of equation, 230, 279
 versal, 231, 252, 255, 260, 278

deformation of matrix, 149
 induced, 149
 infinitesimally symplectic, 163, 165
 infinitesimally symplectic miniversal, 163, 166–76
 infinitesimally symplectic versal, 162, 163, 165
 miniversal, 149, 150, 154, 155, 157, 158–62, 178, 179, 180, 182, 183
 versal, 148, 149, 151, 153–4

deformation of vector field, 195, 198, 199,
see also deformation of equation
 nondegenerate, 199, 254, 255, 260
 versal, 195, 196, 197, 199, 200, 252, 255, 260, 409, *see also* deformation of equation, versal

domain
 Poincaré, 71, 79, 81
 Siegel, 71

equivalent
 strongly, 259
 topologically, 191
 weakly, 259

foliation, 3, 35, 36, 37, 44, 47
 global invariant, 36
 stable, 37, 47
 unstable, 44, 47

germ, 195

global center manifold, *see* center manifold
 existence of, 2, 4, 48
 smoothness of, 2, 12–13, 48
 uniqueness of, 2, 4

group
 dihedral, D_q , 106, 381
 flip, K_n , 106, 178
 Lie, 115, 151
 orthogonal, $O(n)$, 106
 special orthogonal, $SO(n)$, 106
 Z_q , 106, 111, 177–8, 229

Hamiltonian function, 122–3, 127, 129, 131, 133, 208, 343, 407, 432
 normal form of, 132, *see also* normal form, H_2

Hamiltonian system, 113, 122–3, 127, 128, 129, 139, 208, 233, 267, 276, 284, 343, 351, 377, 407, 432
 normal form of, 132, 189–90, *see also* normal form, H_2

Hermitian scalar product, 154, 165

Index

heteroclinic orbit, 31, 34, 227, 229, 272, 284, 298, 338, 344, 360, 371

homoclinic
 loop, 214, 215, 221, 225, 226, 241, 245, 276, 394, 396, 400, 407, 433, 446
 orbit, 31, 34, 213, 229, 233, 235, 241, 266–8, 446

infinitesimally symplectic linear map, 123

infinitesimally symplectic mapping, 117
 decomposable, 117
 indecomposable, 117, 118–22

infinitesimally symplectic matrix, 116, 132, 189

infinitesimally symplectic operator, 114, 155

inner product
 in C_T , 93
 in $\text{gl}(n, R)$, 155, *see also* Hermitian scalar product
 in H_n^k , 54–5, 57, 94, 100
 in $H_{n,T}^k$, 94
 in P_n^k , 134
 in $\text{sp}(n, R)$, 165

integral equation, 6, 18

invariant
 foliation, 3, 35, 36
 manifold, 2, 35

jet, 192, 195

k -linear map, 72
 bounded symmetric, 72

k -tangent, 192

leaf
 stable, 37, 44
 unstable, 44

limit cycle, 204, 209, 211–2, 221, 225, 226, 232, 233, 242, 245, 246, 265–6, 275, 276, 278, 283, 295, 296; 312, 338, 343, 380, 381, 385, 389, 391, 396, 400, 405, 413, 417, 421, 423, 431, 441
 double, 273, 276, 421, 438, 441
 semistable, 414, 446
 triple, 434, 437–8

Lipschitz function, 4, 10, 36

Lipschitz submanifold, 4, 36, 37

local center manifold, *see* center manifold
 equivalence between different, 3, 35, 47
 existence of, 28–9, 30

local family, 196
 equivalence of, 196
 induced, 196

Lyapunov coefficient, 389, 390
 dual, 405

- matrix representation, 55, 60, 65, 66, 93, 101, 104, 105, 109, 118, 138, 142, 217
 method, 55, 68, 101, 103, 109, 141, 188
 Melnikov function, 221
 Melnikov integral, 27
 monodromy matrix, 90, 95
- near identity transformation (change of coordinates), 50, 68, 86, 99
 with symmetry, 108
 symplectic, 131
 T -periodic, 92
- nondegenerate, 50, 116, 250, 355, 376, 378
 condition, 191, 254
 deformation, 199, 201, 254, 255
- normal form, 1, 50, 70, 81, 86, 116, 129, 188–90, 204, 229, 230, 335, 353, 381, 383, 384, 385, *see also* A-normal form
 Birkhoff, 140
 H_2 , 132, 133, 134, 136–8, 139, 140–2
 of codimension one, 177, 178–80, 189
 of codimension two, 177–8, 180–8, 189
 of equation with periodic coefficients, 89, 189
 of equation with symmetry, 95, 105, 259, 278, 292
 of family of matrices, 149, *see also* deformation of matrix, versal
 of indecomposable nonsemisimple infinitesimally symplectic mapping, 119–22
 of indecomposable semisimple infinitesimally symplectic mapping, 118–19
 of linear Hamiltonian system, 113, 189
 of map near a fixed point, 98, 103, 105
 of nonlinear Hamiltonian system, 122
- orbit, 151, 164
- phase portrait, 151, 228, 231, 232, 233, 246, 247, 252, 261, 273, 278, 291, 298, 299, 331, 335, 337, 339, 355, 369, 414
- Picard–Fuchs equation, 229, 233, 239, 260, 270
- Pliss Reduction Principle, 45
- Poincaré map, 205, 214, 220, 387, 394
- Poisson bracket, 131
- representation of Lie algebra, 188
- residual set, 193–4
- resonance
 1 : q , 229
 strong, 329
 weak, 329
- resonant conditions, 54, 68, 69, 71
 for equation with periodic coefficients, 94
 for Hamiltonian function, 132, 133
 for mapping, 101, 103
- resonant monomial, 54, 67, 69, 71, 79, 81–2, 86, 96
 for equation with periodic coefficients, 94–5
 for Hamiltonian function, 132, 133
 for mapping, 101, 102, 103
- reverse lexicographic ordering, 60–1, 62, 63, 92, 138, 146
- Riccati equation, 237, 269
- rotated vector field, 247, 313
- saddle quantity, 406
- small divisor condition, 83, 84
- S - N decomposition, 65–8, 95, 101–2, 138–9, 143
- S -symmetric monomial, 109–10
- stable manifold, 213, 219, 225, 234, 394, 395, 396
- structural stable, 191
- symmetry, 147, 276, 350
 flip, 178, 183–4, 186
 group Γ , 106, 148
 of order 2, 259
 of order 3, 278
 of order 4, 292
 of order ≥ 5 , 328
 reflection, 179, *see also* symmetry, flip
 S -, 105–7, 108, 109, 110, 111, 112, 147
 Z_q , 113–15, 177–8, 182–3, 380
- symplectic
 basis, 117
 diffeomorphism, 122, 123, 124, 127, 128, 129
 form, 116, 117
 operator, 115
 subspace, 117
 transformation, 115, 122
 vector space, 116–17
- symplectically
 conjugate, 116
 similar, 116
- Theorem
 Bendixson, 304
 Binomial, 100
 Converse of Taylor's, 78
 Division, 194–5
 Fiber Contraction, 48
 Green's, 345
 Homoclinic Bifurcation, 424
 Hopf Bifurcation, 204, 208, 209, 226, 424
 Implicit Function, 72, 80, 83, 194, 206, 210, 241, 242, 248, 273–4, 282, 424

Cambridge University Press

978-0-521-37226-8 - Normal Forms and Bifurcation of Planar Vector Fields

Shui-Nee Chow, Chengzhi Li and Duo Wang

Index

[More information](#)

472

Theorem (*cont.*)

Jet transversality, 193, 226

Main Value, 236

Malgrange Preparation, 194, 249, 263,
388

Poincaré, 70, 71–2, 80, 82, 83, 189

Siegel's, 70, 82, 83, 89, 189

Takens's, 143, 144, 189

Taylor's, 76, 77

Uniform Contraction Mapping, 10, 39,
42

Index

time one mapping, 128

truncation operator, 126, 143

transversality, 152, 153–4, 165, 192–3, 203,
254unstable manifold, 213, 219, 234, 394, 395,
396variation of constants formula, 6, 38, 145,
224

weak focus, 385, 388