

Pohjanpelto, P. J.

1. *Symmetries of Maxwell's Equations*, Ph.D. Thesis, University of Minnesota, 1989.
2. First order generalized symmetries of Maxwell's equations, *Phys. Lett. A* **129** (1988), 148–150.

Poincaré, H.

1. *Les Méthodes Nouvelles de la Mécanique Céleste*, vol. 3, Gauthiers-Villars, Paris, 1892.

Pommaret, J. F.

1. *Systems of Partial Differential Equations and Lie Pseudogroups*, Gordon & Breach, New York, 1978.
2. *Differential Galois Theory*, Gordon & Breach, New York, 1983.

Pontryagin, L. S.

1. *Topological Groups*, 2nd ed., Gordon & Breach, New York, 1966.

Posluszny, J. and Rubel, L. A.

1. The motions of an ordinary differential equation, *J. Diff. Eq.* **34** (1979), 291–302.

Pucci, P. and Serrin, J.

1. A general variational identity, *Indiana Univ. Math. J.* **35** (1986), 681–703.

Ramakrishnan, V. and Schaettler, H.

1. Controlled invariant distributions and group invariance, *J. Math. Syst. Est. Control* **1** (1991), 263–278.

Riquier, Ch.

1. Sur une question fondamentale du calcul integrale, *Acta Math.* **23** (1900), 203–332.

Ritt, J. F.

1. *Differential Algebra*, Colloq. Publ., vol. 33, Amer. Math. Soc., Providence, R.I., 1950.

Rosen, G.

1. Nonlinear heat conduction in solid  $H_2$ , *Phys. Rev. B* **19** (1979), 2398–2399.
2. Restricted invariance of the Navier–Stokes equation, *Phys. Rev. A* **22** (1980), 313–314.

Rosenau, P.

1. A note on the integration of the Emden–Fowler equation, *Int. J. Nonlinear Mech.* **19** (1984), 303–308.

Rosenau, P. and Schwarzmeier, J. L.

1. Similarity solutions of systems of partial differential equations using MACSYMA, Courant Inst. of Math. Sci., Magneto-Fluid Dynamics Division, Report No. COO-3077-160 MF-94, 1979.

Rosencrans, S. I.

1. Conservation laws generated by pairs of non-Hamiltonian symmetries, *J. Diff. Eq.* **43** (1982), 305–322.
2. Computation of higher order symmetries using MACSYMA, *Comp. Physics Commun.* **38** (1985), 347–356.

Rubel, L. A.

1. The motions of a partial differential equation, *J. Diff. Eq.* **48** (1983), 177–188.

Santini, P. and Fokas, A. S.

1. Recursion operators and biHamiltonian structures in multi-dimensions. I, *Commun. Math. Phys.* **115** (1988), 375–419.

Sattinger, D. H.

1. *Group-Theoretic Methods in Bifurcation Theory*, Lecture Notes in Math., No. 762, Springer-Verlag, New York, 1979.

Schouten, J. A. and Struik, D. J.

1. *Einführung in die Neueren Methoden der Differentialgeometrie*, vol. 1, P. Noordhoff N.V., Groningen-Batavia, 1935.

Schreier, O.

1. Abstrakte kontinuierliche Gruppen, *Abh. Math. Seminar Hamburg Univ.* **4** (1926), 15–32.

Schütz, J. R.

1. Prinzip der absoluten Erhaltung der Energie, *Nachr. König. Gesell. Wissen. Göttingen, Math.-Phys. Kl.* (1897), 110–123.

Schwarz, F.

1. Automatically determining symmetries of partial differential equations, *Computing* **34** (1985), 91–106.

Sedov, L. I.

1. *Similarity and Dimensional Methods in Mechanics*, Academic Press, New York, 1959.

Semenov–Tian–Shanskii, M. A.

1. What is a classical R-matrix?, *Func. Anal. Appl.* **17** (1983), 259–272.

Serre, D.

1. Invariants et dégénérescence symplectique de l'équation d'Euler des fluides parfaits incompressibles, *C. R. Acad. Sci. Paris* **298** (1984), 349–352.

Seshadri, R. and Na, T. Y.

1. *Group Invariance in Engineering Boundary Value Problems*, Springer-Verlag, New York, 1985.

Shakiban, C.

1. A resolution of the Euler operator II, *Math. Proc. Camb. Phil. Soc.* **89** (1981) 501–510.

Shapovalov, A. V. and Shirokov, I. V.

1. Symmetry algebras of linear differential equations, *Theor. Math. Phys.* **92** (1992), 697–705.

Shokin, Yu. I.

1. *The Method of Differential Approximation*, Springer-Verlag, New York, 1983.

Smale, S.

1. Topology and mechanics. I, *Invent. Math.* **10** (1970), 305–331.

Sokolov, V. V.

1. On the symmetries of evolution equations, *Russ. Math. Surveys* **43**:5 (1988), 165–204.

Sokolov, V. V. and Shabat, A. B.

1. Classification of integrable evolution equations, *Math. Phys. Rev.* **4** (1984), 221–280.

Souriau, J.-M.

1. *Structure des Systèmes Dynamiques*, Dunod, Paris, 1970.

Steinberg, S.

1. Symmetry operators, in *Proceedings of the 1979 MACSYMA User's Conference*, V. E. Lewis, ed., Washington, 1979, pp. 408–444.
2. Symmetries of differential equations, Univ. of New Mexico preprint, 1983.

Steinberg, S. and Wolf, K. B.

1. Symmetry, conserved quantities and moments in diffusive equations, *J. Math. Anal. Appl.* **80** (1981), 36–45.

Stephani, H.

1. *Differential Equations: Their Solution Using Symmetries*, Cambridge Univ. Press, New York, 1989.

Steudel, H.

1. Über die Zuordnung zwischen Invarianzeigenschaften und Erhaltungssätzen, *Zeit. Naturforsch.* **17A** (1962), 129–132.
2. Eine Erweiterung des ersten Noetherschen Satzes, *Zeit. Naturforsch.* **17A** (1962), 133–135.
3. Die Struktur der Invarianzgruppe für lineare Feldtheorien, *Zeit. Naturforsch.* **21A** (1966), 1826–1828.
4. Noether's theorem and higher conservation laws in ultrashort pulse propagation, *Ann. Physik* **32** (1975), 205–216.
5. Noether's theorem and the conservation laws of the Korteweg–de Vries equation, *Ann. Physik* **32** (1975), 445–455.

Strauss, W. A.

1. Nonlinear invariant wave equations, in *Invariant Wave Equations*, G. Velo and A. S. Wightman, eds., Lecture Notes in Physics, No. 73, Springer-Verlag, New York, 1978, pp. 197–249.

Sudarshan, E. C. G. and Mukunda, N.

1. *Classical Dynamics: A Modern Perspective*, Wiley, New York, 1974.

Sussmann, H. J.

1. Orbits of families of vector fields and integrability of systems with singularities, *Bull. Amer. Math. Soc.* **79** (1973), 197–199.

Svinolupov, S. I. and Sokolov, V. V.

1. Factorization of evolution equations, *Russ. Math. Surveys* **47:3** (1992), 127–162.

Takens, F.

1. A global version of the inverse problem of the calculus of variations, *J. Diff. Geom.* **14** (1979), 543–562.

Taylor, G. I.

1. The formation of a blast wave by a very intense explosion. I. Theoretical discussion, *Proc. Roy. Soc. London* **201A** (1950), 159–174.
2. The formation of a blast wave by a very intense explosion. II. The atomic explosion of 1945, *Proc. Roy. Soc. London* **201A** (1950), 175–186.

Taylor, M.

1. *Pseudodifferential Operators*, Princeton Univ. Press, Princeton, N.J., 1981.

Thirring, W. E.

1. *A Course in Mathematical Physics*, vol. 1, Springer-Verlag, New York, 1978.

Toda, M.

1. *Theory of Nonlinear Lattices*, Springer-Verlag, New York, 1981.

Tsujishita, T.

1. On variation bicomplexes associated to differential equations, *Osaka J. Math.* **19** (1982), 311–363.
2. Formal geometry of systems of differential equations, *Sugaku Exp.* **3** (1990), 25–73.

Tu, G.-Z.

1. A commutativity theorem of partial differential operators, *Commun. Math. Phys.* **77** (1980), 289–297.

Tulczyjew, W. M.

1. The Lagrange complex, *Bull. Soc. Math. France* **105** (1977), 419–431.
2. The Euler–Lagrange resolution, in *Differential Geometric Methods in Mathematical Physics*, P. L. Garcia, A. Pérez-Rendón, and J.-M. Souriau, eds., Lecture Notes in Math., No. 836, Springer-Verlag, New York, 1980, pp. 22–48.

Vainberg, M. M.

1. *Variational Methods for the Study of Nonlinear Operators*, Holden-Day, San Francisco, 1964.

van der Schaft, A. J.

1. Symmetries in optimal control, *SIAM J. Control Optimization* **25** (1987), 245–259.

van der Vorst, R.C.A.M.

1. Variational identities and applications to differential systems, *Arch. Rat. Mech. Anal.* **116** (1991), 375–398.

Verdier, J.-L.

1. Groupes quantiques, *Astérisque* **152–153** (1987), 305–319.

Vessiot, E.

1. Sur l'intégration des systèmes différentiels qui admettent des groupes continus de transformations, *Acta. Math.* **28** (1904), 307–349.

Vilenkin, N. J.

1. *Special Functions and the Theory of Group Representations*, Amer. Math. Soc., Providence, R.I., 1968.

Vinogradov, A. M.

1. On the algebra-geometric foundations of Lagrangian field theory, *Sov. Math. Dokl.* **18** (1977), 1200–1204.
2. Hamilton structures in field theory, *Sov. Math. Dokl.* **19** (1978), 790–794.
3. The  $\mathcal{C}$ -spectral sequence, Lagrangian formalism and conservation laws. I. The linear theory, *J. Math. Anal. Appl.* **100** (1984), 1–40.
4. The  $\mathcal{C}$ -spectral sequence, Lagrangian formalism and conservation laws. II. The nonlinear theory, *J. Math. Anal. Appl.* **100** (1984), 41–129.
5. Local symmetries and conservation laws, *Acta Appl. Math.* **2** (1984), 21–78.

Vladimorov, V. S. and Volovich, I.V.

1. Conservation laws for non-linear equations, *Usp. Mat. Nauk* **40**:4 (1985), 17–26.
2. Local and nonlocal currents for nonlinear equations, *Theor. Math. Phys.* **62** (1985), 1–20.

Volterra, V.

1. *Leçons sur les Fonctions de Lignes*, Gauthier-Villars, Paris, 1913.

Wahlquist, H. D. and Estabrook, F. B.

1. Prolongation structures of nonlinear evolution equations, *J. Math. Phys.* **16** (1975), 1–7.

Warner, F. W.

1. *Foundations of Differentiable Manifolds and Lie Groups*, Scott, Foresman, Glenview, Ill., 1971.

Weinstein, A.

1. Symplectic manifolds and their Lagrangian submanifolds, *Adv. Math.* **6** (1971), 329–346.
2. Sophus Lie and symplectic geometry, *Expo. Math.* **1** (1983), 95–96.
3. The local structure of Poisson manifolds, *J. Diff. Geom.* **18** (1983), 523–557.
4. Stability of Poisson–Hamilton equilibria, *Contemp. Math.* **28** (1984), 3–13.

Weisner, L.

1. Generating functions for Hermite functions, *Canad. J. Math.* **11** (1959), 141–147.

Weiss, J., Tabor, M. and Carnevale, G.

1. The Painlevé property for partial differential equations, *J. Math. Phys.* **24** (1983), 522–526.

Weyl, H.

1. *Die Idee der Riemannschen Fläche*, B. G. Teubner, Berlin, 1923.

Whitham, G. B.

1. Variational methods and applications to water waves, *Proc. Roy. Soc. London* **299A** (1967), 6–25.
2. *Linear and Nonlinear Waves*, Wiley, New York, 1974.

Whittaker, E. T.

1. *A Treatise on the Analytical Dynamics of Particles and Rigid Bodies*, Cambridge University Press, Cambridge, 1937.

Widder, D. V.

1. *The Heat Equation*, Academic Press, New York, 1975.

Wilczynski, E. J.

1. An application of group theory to hydrodynamics, *Trans. Amer. Math. Soc.* **1** (1900), 339–352.

Wilson, G.

1. Commuting flows and conservation laws for Lax equations, *Math. Proc. Camb. Phil. Soc.* **86** (1979), 131–143.

Wussing, H.

1. *The Genesis of the Abstract Group Concept*, MIT Press, Cambridge, Mass., 1984.

Zakharov, V. E. and Fadeev, L. D.

1. Korteweg–de Vries equation: a completely integrable Hamiltonian system, *Func. Anal. Appl.* **5** (1971), 280–287.

Zakharov, V. E. and Konopelchenko, B. G.

1. On the theory of recursion operator, *Commun. Math. Phys.* **94** (1984), 483–509.

Zharinov, V.

1. *Geometrical Aspects of Partial Differential Equations*, World Scientific, Singapore, 1992.

# Symbol Index

Symbol	Description and page number(s)
$\mathcal{A}$	algebra of differential functions 288
$\mathcal{A}^m$	space of $m$ -tuples of differential functions 288
$\text{Ad}$	adjoint representation 199
$\text{Ad}^*$	co-adjoint representation 406
$\text{ad } \mathbf{v}$	adjoint vector field 200
$\text{ad}^* \mathbf{v}$	co-adjoint vector field 406
$\text{Ai}$	Airy function 209
$\mathbf{B}$	Poisson map on cotangent space 399
$\text{Bi}$	Airy function 209
$C$	distinguished function 392, 410
$\mathcal{C}$	distinguished functional 446
$\mathcal{C}$	formal conservation law 349
$C^k$	space of $k$ -times differentiable functions 4
$C^\infty$	space of smooth functions 4
$c_{jk}^i$	structure constant 50
$\text{cn}$	Jacobi elliptic function 194
$\text{Curl}$	total curl 265
$d$	differential 32, 54, 57
$\hat{d}$	vertical differential 353
$\mathbf{d}$	dilatational vector field 124
$\mathbf{D}$	total differential 351, 369
$\mathcal{D}$	dilatational symmetry operator 306
$\mathcal{D}$	differential operator 168, 308, 318
$\mathcal{D}$	Hamiltonian operator 435
$\mathcal{D}^*$	adjoint differential operator 328, 329
$\mathcal{D}$	pseudo-differential operator 319
$\mathcal{D}$	formal symmetry 323, 349
$\mathcal{D}^{-1}$	inverse of pseudo-differential operator 320
$\sqrt[n]{\mathcal{D}}$	$n$ -th root of pseudo-differential operator 321
$\mathcal{D}^{i/n}$	fractional power of pseudo-differential operator 321

- $D_i$  or  $D_x$   
 $D_x^{-1}$   
 $D_J$   
 $(-D)_J$   
 $D_P$   
 $D_P^*$   
 $D_x \zeta$   
 $D(\eta^1, \dots, \eta^p)/D(x^1, \dots, x^p)$   
 $dx^i$   
 $dx^i_j$   
 $dx^{\hat{i}j}$   
 $dx^J$   
 $du^j_z$   
 $\det$   
 $\operatorname{div}$   
 $\operatorname{Div}$   
 $e$   
 $E$   
 $E_x$   
 $E_x^J$   
 $E^{(k)}$   
 $E(m)$   
 $e^{\varepsilon A}$   
 $\operatorname{erf}$   
 $\exp$   
 $\exp(\varepsilon v)$   
 $\exp(\varepsilon v)$   
 $\exp(\varepsilon v_Q)$   
 $\mathcal{F}$   
 $G$   
 $G^+$   
 $g$   
 $g^*$   
 $G_c$   
 $G^{(r)}$   
 $g^{(r)}$   
 $G_x$   
 $G^x$   
 $g^x$   
 $G^x$   
 $G_x$   
 $g_\alpha$   
 $g \cdot f$   
 $G/H$   
 $\operatorname{GL}(n)$  or  $\operatorname{GL}(n, \mathbb{R})$   
 $\operatorname{GL}^+(n)$   
 $\operatorname{gl}(n)$   
 $\operatorname{GL}(m, n)$   
 $\operatorname{Grass}(m, n)$   
 $\operatorname{Grass}(p, M)$   
 $h$   
 $h$   
 $\hbar$   
 $H$   
 $H$  and  $H^*$   
 total derivative 109, 289, 318, 355, 369  
 inverse total derivative operator 313, 319  
 higher order total derivative 109  
 signed higher order total derivative 245  
 Fréchet derivative of differential function  $P$  307  
 adjoint of Fréchet derivative 329  
 total Jacobian matrix 233  
 total Jacobian determinant 240, 387  
 basis differential one-form 54, 351  
 basis differential  $(m-1)$ -form 59  
 basis differential  $(m-2)$ -form 60  
 basis differential form 55, 351  
 basis vertical one-form 353, 440  
 determinant 14  
 divergence 59, 74  
 total divergence 248, 289, 352, 357  
 identity element of group 14  
 Euler operator 246, 289, 329, 363, 369  
 Euler operator 246  
 higher Euler operator 365  
 higher Euler operator 366  
 Euclidean group of  $\mathbb{R}^m$  71, 73  
 matrix exponential 29  
 error function 157  
 exponential map 48  
 flow of vector field  $v$  28  
 one-parameter subgroup 45  
 flow of evolutionary vector field  $v_Q$  297, 380, 388  
 space of functionals 356  
 Lie group 15, 90  
 identity component of Lie group 17  
 Lie algebra 42, 43, 49, 52  
 dual to Lie algebra 397  
 translation group 77  
 subgroup of solvable group 151  
 subalgebra of solvable Lie algebra 151  
 local group of transformations defined at  $x$  21  
 isotropy group 73  
 isotropy subalgebra 73  
 scaling group 77  
 residual symmetry group 422  
 isotropy subalgebra 422  
 transformed function 90  
 quotient group 72  
 general linear group of  $\mathbb{R}^n$  14  
 identity component of general linear group 17  
 Lie algebra of  $n \times n$  matrices 44  
 space of  $m \times n$  matrices of maximal rank 69  
 Grassmann manifold 69  
 Grassmann bundle 240  
 homotopy operator 63, 64  
 variational homotopy operator 362  
 vertical homotopy operator 354  
 Hamiltonian function 392, 395  
 total homotopy operators 372

- $\mathcal{H}$
- $\mathbb{H}^m$
- $\mathcal{H}|_x$
- $\text{He}_n$
- $i$
- $I$
- $I^{(n)}$
- $\tilde{I}^{(n)}$
- $I_\star^{(n)}$
- $l_Q$
- $l_u$
- $i_x$
- $\mathcal{I}_x$
- $J$
- $\tilde{J}$
- $J!$  or  $\tilde{J}!$
- $J$  or  $J_\Delta$
- $J^i$
- $K$
- $K_g$
- $\mathcal{K}|_x$
- $\mathcal{L}[u] = \int L \, dx$
- $m$
- $\mathbf{m}$
- $M$
- $M$
- $M$
- $M$
- $M_g$
- $M_x$
- $M^{(n)}$
- $M_\star^{(n)}$
- $M_{n \times n}$
- $M/G$
- $(M/G)^{(n)}$
- $(\widetilde{M/G})^{(n)}$
- $(M/G)_\star^{(n)}$
- mod
- $\mathcal{O}$
- $O(n)$
- $O(\varepsilon^n)$
- order
- $P$
- $p_k$
- $p^{(n)}$
- $\text{pr}^{(n)} f$
- $\text{pr}^{(n)} g$
- $\text{pr}^{(n)} G$
- $\text{pr}^{(n)} \mathbf{v}$
- $\text{pr } \mathbf{v}$
- $\text{pr } \mathbf{v}_Q$
- system of vector fields 39, 400
- Hamiltonian functional 435
- upper half space 66
- space of Hamiltonian vector fields 400
- Hermite polynomial 192
- group inverse 15, 18
- inversion 73, 125
- identity matrix 14
- invariant space 224, 229
- “nice” invariant space 231
- extended invariant space 224
- total interior product operator 369
- total interior product operator 372
- inversional vector field 124
- inversional symmetry operator 306
- structure matrix for Poisson bracket 394, 432
- transformed multi-index 98, 366
- multi-index factorial 98, 366
- Jacobian matrix 103, 111, 232, 250
- structure function for Poisson bracket 394
- symplectic structure matrix 400, 430
- conjugation map 199
- kernel of Poisson map  $\mathbf{B}$  400
- functional 243, 356
- group operation 15, 18
- dilatational vector field 256
- manifold 3
- open subset of space of independent and dependent variables 90
- matrix for characteristics 164
- dilatational symmetry operator 340
- domain of definition of transformation  $g$  21
- vertical slice 352
- jet space 96, 112, 220
- extended jet space 220
- space of  $n \times n$  matrices (see  $\text{gl}(n)$ ) 15
- quotient manifold 210
- jet space of quotient manifold 231
- “nice” jet space of quotient manifold 231
- extended jet space of quotient manifold 226
- modular addition 7
- orbit 22
- orthogonal group 15
- order of vanishing 27
- order of pseudo-differential operator 320
- momentum map 421
- binomial coefficient 95
- binomial coefficient 95
- prolongation of function  $f$  96, 220
- prolongation of group transformation  $g$  98, 223
- prolongation of group  $G$  98, 223
- prolongation of vector field  $\mathbf{v}$  101, 110, 224, 289
- prolongation of (generalized) vector field  $\mathbf{v}$  289–291, 388
- prolongation of evolutionary vector field 291, 369



- $\text{pr } v_Q(\mathcal{Q})$   
 $\text{pr}^{(n)} \Gamma$   
 $\bar{Q}$  or  $Q_\alpha$   
 $Q$  or  $\bar{Q}_\alpha$   
 $\mathbb{Q}$   
 $\mathcal{R}$   
 $\mathcal{R}$   
 $\mathbf{R}$   
 $\mathbb{R}$   
 $\mathbb{R}^+$   
 $R_\mu$   
 $\mathbb{R}^m$   
 $r_{xy}$   
 $\mathcal{R}_{xy}$   
 $\mathbb{R}P^m$   
 $\mathcal{S}_F$   
 $S^m$   
 $\mathcal{S}_\alpha$   
 $\mathcal{S}_\Delta$   
 $\mathcal{S}_\Delta^*$   
  
 $\mathcal{S}_{\Delta/G}$   
 $\mathcal{S}_{\Delta/G}^*$   
 $\text{SL}(n)$  or  $\text{SL}(n, \mathbb{R})$   
 $\mathfrak{sl}(n)$   
 $\text{sn}$   
 $\text{SO}(n)$   
 $\mathfrak{so}(n)$   
 $\text{SO}(p, q)$   
 $\text{Sp}(n)$   
 $T$   
 $T_0$   
 $T^m$   
 $T(n)$   
 $TM$   
 $TM|_x$   
 $T^*M$   
 $T^*M|_x$   
 $u$  or  $u^\alpha$   
 $[u]$   
 $\mathcal{U}$   
 $U$   
 $U$   
 $u_i$   
 $u_i$   
 $U_n$   
 $u^{(n)}$   
 $U^{(n)}$   
 $U_z$   
 $U_\alpha$   
 $u_i^\alpha$   
 $u_j^\alpha$   
 $u_{j,i}^\alpha$   
 $u_{mr}^\alpha$   
  
 Lie derivative of differential operator 308  
 prolongation of submanifold  $\Gamma$  220  
 characteristic of vector field 115, 291  
 characteristic of conservation law 266, 330  
 rational numbers 14  
 recursion operator 304, 323, 455  
 hereditary operator 315  
 Runge–Lenz vector 335, 379  
 real numbers 7, 14, 43  
 positive real numbers 16  
 right multiplication map 42  
 $m$ -dimensional Euclidean space 2, 15  
 rotational vector field 124, 129  
 rotational symmetry operator 306  
 real projective space 69  
 subvariety determined by function  $F$  77  
 $m$ -dimensional sphere 4  
 level set of momentum map 422  
 subvariety for system of differential equations 97, 222  
 extended subvariety for system of differential equations 222  
 reduced subvariety 235  
 reduced subvariety 227  
 special linear group of  $\mathbb{R}^n$  18  
 special linear Lie algebra 51  
 Jacobi elliptic function 415  
 special orthogonal group 16  
 Lie algebra of skew-symmetric matrices 47  
 special orthogonal group 177  
 symplectic group 71  
 matrix transpose 15  
 space of evolutionary vector fields 355, 441  
 $m$ -dimensional torus 5, 16  
 group of upper triangular matrices 6  
 tangent bundle of  $M$  25  
 tangent space of  $M$  at  $x$  25  
 cotangent bundle of  $M$  54  
 cotangent space of  $M$  at  $x$  54  
 dependent variables 90  
 dependence on derivatives 288  
 domain of transformation group 20  
 space of dependent variables 90  
 parabolic cylinder function 192  
 ordinary derivative of  $u$ :  $d^i u/dx^i$  137, 246  
 partial derivative of  $u$ :  $\partial u/\partial x^i$  106  
 space of partial derivatives 95  
 partial derivatives of  $u$  up to order  $n$  95  
 jet space 95  
 vertical space 219  
 coordinate chart 3  
 partial derivative of  $u$ :  $\partial u^\alpha/\partial x^i$  110  
 partial derivative of  $u$ :  $\partial_j u^\alpha$  95  
 partial derivative of  $u$ :  $\partial u_j^\alpha/\partial x^i$  109  
 partial derivative of  $u$ :  $\partial^m u^\alpha/\partial t^m$  162

- $u_{mt,j}^a$
- $V$
- $V$
- $v$
- $v$
- $v^*$
- $v_0$
- $v_{\mathcal{D}\theta}$
- $v(f)$
- $v(\omega)$
- $\hat{v}_H$
- $\hat{v}_{\mathcal{X}^n}$
- $\tilde{\gamma}^{(n)}$
- $\tilde{\gamma}^{(n)}$
- $v_Q$
- $v_Q[\mathcal{D}]$
- $v_u$
- $v|_x$
- $v_a$
- $v_a$
- $(\mathcal{V}/G)^{(n)}$
- $(\mathcal{V}/G)^{(n)}$
- $\text{Vol}$
- $W$
- $x$
- $x$  or  $x^i$
- $\hat{x}$
- $X$
- $x^j$
- $\mathbb{Z}$
- $1$  or  $1_x$
- $(-1)^\pi$
- $\Gamma_f$
- $\Gamma^{(n)}$
- $\delta$
- $\delta$
- $\delta_a$  or  $\delta/\delta u^a$
- $\delta_j^i$
- $\Delta$
- $\Delta$
- $\Delta$
- $\Delta/G$
- $\Delta^{(k)}$
- $\Delta(x, u^{(n)}) = 0$
- $\ominus$
- $\theta_f^a$
- $\kappa$
- $\xi^i$
- $\pi$
- $\pi$
- $\pi^k$
- $\pi^{(n)}$
- $\pi_k^n$
- $\phi_\alpha$
- partial derivative of  $u$ :  $\partial_j(\partial^m u^a/\partial t^m)$  163
- local Lie group 18
- parabolic cylinder function 192
- vector field; element of Lie algebra 26, 42, 52, 102
- generalized vector field 289
- exponential vector field 181
- scaling vector field 64
- formal evolutionary vector field 441
- Lie derivative of function  $f$  30
- Lie derivative of differential form  $\omega$  60
- Hamiltonian vector field 392
- Hamiltonian vector field 435
- vertical subvariety 221
- "nice" singular subvariety 231
- evolutionary vector field 116, 291
- $(1, 1)$  Lie derivative 310, 323
- scaling vector field 354
- tangent vector at  $x$  24
- linear symmetry group generator 118
- moving coordinate group generator 129
- quotient singular subvariety 231
- "nice" quotient singular subvariety 231
- volume 74
- parabolic cylinder function 208
- local coordinates 6
- independent variables 90
- parametric variables 86, 186, 189
- space of independent variables 90
- product of independent variables 98
- integers 14
- identity map (of space  $X$ ) 4, 92
- sign of permutation  $\pi$  54
- graph of function  $f$  90, 219
- graph of prolonged function 97
- variational derivative 245
- variational differential 361
- variational derivative 245
- Kronecker symbol 54, 391
- system of differential equations 97, 290
- linear differential operator 306, 336
- Laplacian 247
- reduced system of differential equations 188, 235
- prolonged system of differential equations 166
- differential equation 97
- Poisson bi-vector 432, 441
- basis vertical uni-vector 440
- curvature 113
- coefficient of vector field 26, 102, 289
- permutation 54
- projection to quotient manifold 210
- power product 215
- extended jet space projection 226
- jet space projection 100, 220
- coefficient of vector field 102, 289