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# 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
Ad	adjoint representation 199
Ad*	co-adjoint representation 406
ad $v$	adjoint vector field 200
ad* $v$	co-adjoint vector field 406
Ai	Airy function 209
B	Poisson map on cotangent space 399
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
cn	Jacobi elliptic function 194
Curl	total curl 265
$d$	differential 32, 54, 57
$\hat{d}$	vertical differential 353
$\mathbf{d}$	dilatational vector field 124
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 $D_x$	total derivative 109, 289, 318, 355, 369
$D_x^{-1}$	inverse total derivative operator 313, 319
$D_J$	higher order total derivative 109
$(-D)_J$	signed higher order total derivative 245
$D_P$	Fréchet derivative of differential function $P$ 307
$D_P^*$	adjoint of Fréchet derivative 329
$D_{x^\zeta}$	total Jacobian matrix 233
$D(\eta^1, \dots, \eta^p)/D(x^1, \dots, x^p)$	total Jacobian determinant 240, 387
$dx^i$	basis differential one-form 54, 351
$dx^i$	basis differential $(m - 1)$ -form 59
$dx^{ij}$	basis differential $(m - 2)$ -form 60
$dx^j$	basis differential form 55, 351
$du_j^i$	basis vertical one-form 353, 440
$\det$	determinant 14
$\operatorname{div}$	divergence 59, 74
$\operatorname{Div}$	total divergence 248, 289, 352, 357
$e$	identity element of group 14
$E$	Euler operator 246, 289, 329, 363, 369
$E_a$	Euler operator 246
$E_a^j$	higher Euler operator 365
$E^{(k)}$	higher Euler operator 366
$E(m)$	Euclidean group of $\mathbb{R}^m$ 71, 73
$e^{tA}$	matrix exponential 29
$\operatorname{erf}$	error function 157
$\exp$	exponential map 48
$\exp(\operatorname{ev})$	flow of vector field $v$ 28
$\exp(\operatorname{ev})$	one-parameter subgroup 45
$\exp(\operatorname{ev}_Q)$	flow of evolutionary vector field $v_Q$ 297, 380, 388
$\mathcal{F}$	space of functionals 356
$G$	Lie group 15, 90
$G^+$	identity component of Lie group 17
$g$	Lie algebra 42, 43, 49, 52
$g^*$	dual to Lie algebra 397
$G_c$	translation group 77
$G^{(r)}$	subgroup of solvable group 151
$g^{(r)}$	subalgebra of solvable Lie algebra 151
$G_x$	local group of transformations defined at $x$ 21
$G^x$	isotropy group 73
$g^x$	isotropy subalgebra 73
$G^x$	scaling group 77
$G_a$	residual symmetry group 422
$g_a$	isotropy subalgebra 422
$g \cdot f$	transformed function 90
$G/H$	quotient group 72
$\operatorname{GL}(n)$ or $\operatorname{GL}(n, \mathbb{R})$	general linear group of $\mathbb{R}^n$ 14
$\operatorname{GL}^+(n)$	identity component of general linear group 17
$\operatorname{gl}(n)$	Lie algebra of $n \times n$ matrices 44
$\operatorname{GL}(m, n)$	space of $m \times n$ matrices of maximal rank 69
$\operatorname{Grass}(m, n)$	Grassmann manifold 69
$\operatorname{Grass}(p, M)$	Grassmann bundle 240
$h$	homotopy operator 63, 64
$h$	variational homotopy operator 362
$\hat{h}$	vertical homotopy operator 354
$H$	Hamiltonian function 392, 395
$H$ and $H^*$	total homotopy operators 372

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

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

$u_{mt,J}^a$	partial derivative of $u$ : $\partial_J(\partial^m u^a / \partial t^m)$ 163
$V$	local Lie group 18
$\mathbf{V}$	parabolic cylinder function 192
$\mathbf{v}$	vector field; element of Lie algebra 26, 42, 52, 102
$\mathbf{v}^*$	generalized vector field 289
$\mathbf{v}^*$	exponential vector field 181
$\mathbf{v}_0$	scaling vector field 64
$\mathbf{v}_{\mathcal{D}\theta}$	formal evolutionary vector field 441
$\mathbf{v}(f)$	Lie derivative of function $f$ 30
$\mathbf{v}(\omega)$	Lie derivative of differential form $\omega$ 60
$\mathbf{v}_H$	Hamiltonian vector field 392
$\mathbf{v}_x$	Hamiltonian vector field 435
$\mathbf{v}^{(n)}$	vertical subvariety 221
$\tilde{\mathbf{v}}^{(n)}$	“nice” singular subvariety 231
$\mathbf{v}_Q$	evolutionary vector field 116, 291
$\mathbf{v}_Q[\mathcal{D}]$	(1, 1) Lie derivative 310, 323
$\mathbf{v}_u$	scaling vector field 354
$\mathbf{v} _x$	tangent vector at $x$ 24
$\mathbf{v}_\alpha$	linear symmetry group generator 118
$\mathbf{v}_\alpha$	moving coordinate group generator 129
$(\mathcal{Y}/G)^{(n)}$	quotient singular subvariety 231
$(\mathcal{Y}/G)^{(n)}$	“nice” quotient singular subvariety 231
Vol	volume 74
W	parabolic cylinder function 208
$x$	local coordinates 6
$x$ or $x^i$	independent variables 90
$\hat{x}$	parametric variables 86, 186, 189
$X$	space of independent variables 90
$x^j$	product of independent variables 98
$\mathbb{Z}$	integers 14
$1$ or $1_X$	identity map (of space $X$ ) 4, 92
$(-1)^\pi$	sign of permutation $\pi$ 54
$\Gamma_f$	graph of function $f$ 90, 219
$\Gamma_f^{(n)}$	graph of prolonged function 97
$\delta$	variational derivative 245
$\delta$	variational differential 361
$\delta_a$ or $\delta/\delta u^a$	variational derivative 245
$\delta_j^i$	Kronecker symbol 54, 391
$\Delta$	system of differential equations 97, 290
$\Delta$	linear differential operator 306, 336
$\Delta$	Laplacian 247
$\Delta/G$	reduced system of differential equations 188, 235
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$\Delta(x, u^{(n)}) = 0$	differential equation 97
$\Theta$	Poisson bi-vector 432, 441
$\theta_j^a$	basis vertical uni-vector 440
$\kappa$	curvature 113
$\xi^i$	coefficient of vector field 26, 102, 289
$\pi$	permutation 54
$\pi$	projection to quotient manifold 210
$\pi^k$	power product 215
$\pi^{(n)}$	extended jet space projection 226
$\pi_k^n$	jet space projection 100, 220
$\phi_\alpha$	coefficient of vector field 102, 289