
Index

- $2\frac{1}{2}$ D flows, 54
 Approximate-solution sequence
 2D, L^1 vorticity control, 391
 2D, L^p vorticity control, 391
 Euler and Navier–Stokes, 385
 Euler equation, 391
 Arnold–Beltrami–Childress periodic flows, 60
 Asymptotic filament equation
 with self-stretch in a background flow field, 269
 with self-stretching, 264
 Axisymmetric flows
 with swirl, 64
 without swirl, 62

 Banach space, 136, 138, 139
 Banach–Alaoglu theorem, 109, 393
 Beltrami flows, 56
 Bennett’s inequality, 247
 Bernoulli’s law, 365
 Biot–Savart law, 71
 Birkhoff–Rott equation, 366
 Bounded mean oscillation (BMO), 322
 Boussinesq equations
 as a model for axisymmetric swirling flows, 186
 Brownian motion, 190

 Calderon–Zygmund inequality, 322
 Compactness lemma for measures, 393
 Concentrations
 in solution sequences of the Euler equation, 375
 Contour dynamics equation (CDE), 330
 Convergence
 strong and weak, 109

 Defect measure
 reduced, 379
 weak*, 378
 Deformation matrix, 6
 Discrete Fourier transform, 372
 Distribution derivative, 73
 Distribution function, 387

 Electron patch, 504
 Electron sheets
 singularity formation, 513
 Elliptical vortices, 304
 Energy method, 86
 basic energy estimate, 87
 in two dimensions, 95
 Euler equations, 2
 Eulerian frame, 82

 Fluid impulse, 24
 Fokker–Planck equation, 194
 Fourier filter
 for computing vortex sheets, 372

 Grönwall’s lemma, 89, 149, 344

 Hadamard lemma, 142
 Hasimoto transform, 258
 Heat equation, 94, 121
 Helicity, 24
 Helmholtz’s conservation of vorticity, 23
 Hessian, of pressure, 11
 Hilbert transform, 368
 Hodge decomposition, 71
 in H^m , 99
 Hodge decomposition of vector fields, 30
 Hölder space, 140, 326
 Homoclinic orbit, 308

 Integro-differential equation for particle trajectories, 82, 137
 Inviscid flows
 approximate by high Reynolds number flows, 90

 Jet flow, 8

 Kelvin’s conservation of circulation, 23
 Kelvin–Helmholtz instability, 367
 Kelvin–Stuart cat’s-eye flow, 53
 Kinetic energy, 24
 locally finite, 360
 Kinetic energy
 in two dimensions, 92
 Kirchoff ellipse, 306
 Klein, R., 257

- Lagrangian frame, 82
- Lagrangian particle, 4
- Leray's formulation, 30
- Level sets
 - analogy with vortex lines, 178
- Linearized self-induction equations
 - along a straight-line filament, 261
- Lions–Aubin compactness lemma, 394
- Lions–Aubin lemma, 394, 428
- Lipschitz continuity
 - on Banach space, 139
- Melnikov method, 309
- Mollifier, 98
- Navier–Stokes equations, 2
- Neu's unsteady elliptical columnar vortex in
 - an imposed strain flow, 307
- Newtonian potential, 30
- Nonlinear Schrödinger equation
 - cubic, 260
- Oscillations
 - in solutions sequences of the Euler equation, 375
- Particle-trajectory map, 4
- Picard theorem on a Banach space, 100, 139, 336
- Point vortex
 - interacting filaments, 278
- Point-vortex approximation, 370
 - round-off error, 371
- Point-vortex method, 191
- Point vortices, conserved quantities, 279
- Potential theory, 71, 365
- Pressure, 2
- Propagation of regularity
 - for vortex patches, 326
- Pseudoenergy
 - 2D fluids, 426
- Quasi-geostrophic active scalar
 - two-dimensional, 177
- Radial eddies, 47
- Radial-energy decomposition, 93
- Rate-of-strain matrix, 6
- Regularization
 - by mollifiers, 98
- Rellich compactness lemma, 394
- Reynolds number, 2
- Riesz representation theorem, 393
- Rosenhead, 191
- Rotating jet, 11
- Schwartz space, 393
- Schwarz inequality, 89
- Self-induction approximation, 258
- Self-induction equation for an isolated vortex
 - filament, 258
- Serret–Frenet formulas, 258
- Shear layer
 - basic, 14
 - Burgers, 18
 - inviscid strained, 17
 - viscous, 15
 - viscous strained, 18
- Singular integral operator (SIO), 76
- Singularities
 - 3D axisymmetric flows, 185
- Singularities in 3D Euler
 - numerical studies, 180
- Singularity
 - finite-time
 - 3D Euler, 168
- Sobolev inequality, 97
- Sobolev norm, 97
- Sobolev space, 97, 393
- Sobolev's lemma, 394
- Stochastic differential equation (SDE), 194
- Strain flow, 9
- Strang's algorithm, 120
- Taylor–Green vortex, 172
- Viscosity, 2
- Viscous rotating eddy, 67
- Viscous-splitting algorithm, 119
 - consistency of, 124
 - stability of, 124
- Viscous strained shear layers
 - vortex methods, 192
- Vlasov–Poisson equations, 498
 - approximate-solution sequences, 507
 - computational particle methods, 510
 - nonlinear transport equations, 502
 - nonuniqueness of weak solutions in the
 - one-component case, 518
 - pseudo-Fokker–Plank regularization, 501
 - single-component case, 499
 - two-component case, 500, 524
- Vortex cores, 191
- Vortex filaments
 - asymptotic theory of, 256, 383
 - equations for N interacting exactly
 - parallel, 279
 - kinks, folds, and hairpins, 274
 - simplified equations for the interaction of nearly
 - parallel, 281
- Vortex line, 21
- Vortex methods, 190
 - 3D inviscid, 211
 - Chorin, 191
 - consistency error, 221
 - convergence of inviscid, 216
 - point vortices, 191
 - random vortex method (2D), 232
 - stability error, 225
- Vortex patches, 329
- Vortex patches, global regularity of the boundary, 345
- Vortex sheet, 363
 - analytic initial data, 370
- Vortex sheet, viscous regularization of, 374
- Vortex sheet, vortex-patch regularization of, 373
- Vortex-blob regularization of a vortex sheet, 372
- Vortex-line-stretching factor
 - singularities in 3D Euler, 171
- Vortex-sheet initial data, 405

- Vortex-sheet, surface tension regularization
 - of, 374
- Vorticity, 6
- Vorticity amplification
 - 1D model for, 173
- Vorticity equation, 12
- Vorticity rotation matrix, 6
- Vorticity-stream formulation
 - 2D flows, 44
 - periodic flows, 49
- Vorticity-transport formula, 20

- Weak formulation of the Euler equation
 - primitive-variable form, 361

- Weak solution
 - 2D, vorticity in L^1 , 403
 - existence in two dimensions with vorticity in $L^p \cap L^1$, 399
 - in primitive-variable form, 390
 - with initial vorticity in L^∞ , 303
- Weak vorticity-stream formulation of the Euler equations, 309
- Wiener process, 197

- Young measure, 377
- Yudovich, V. I., 311

- Zero diffusion limit of Navier–Stokes, 392