Index

J-integral, 427
$L_2$-norm, 7, 81, 137, 394
$\bar{B}$-concept, 275, 389, 396
$\bar{F}$-concept, 395
$C^\infty$-continuous shape functions, 449
$C^p$-continuous shape functions, 477
$\pi$-plane, 226, 249
$h$-type instability, 300
$k$-refinement, 477
$p$-refinement, 477
$s$-type instability, 301
acceleration, 146, 150, 151, 153
acoustic tensor, 181
active yield surface, 258
adhesion, 222
adhesive fracture, 501
aging, 284
analysis-suitable T-meshes, 481
analysis-suitable T-splines, 481
angle of internal friction, 224
anisotropic damage models, 198
anisotropic yield functions, 245
apex of the yield surface, 225, 256, 263
arc-length method, 116, 320
associated flow rule, 230
automatic load incrementation, 135
average acceleration scheme, 153
axial vector, 335, 417
B-spline, 475, 487
Bézier elements, 485, 487
Bézier extraction, 485
Bézier mesh, 485, 489
back stress tensor, 234
back bone inviscid plasticity, 295
Bailey–Norton power law, 288
balance of moment of momentum, 18, 32
balance of momentum, 31, 190, 365, 392, 452, 466
bandwidth, 444, 446, 476
Bauschinger effect, 233
bending moment, 309, 312, 319, 346
Bernstein polynomials, 484, 486
bifurcation analysis, 181
bifurcation point, 102, 130, 132, 133
Biot strain tensor, 397
Biot stress tensor, 368, 397
Boltzmann continuum, 18
bond-slip behaviour, 207
boundary conditions, 212
bounding surface plasticity, 235, 242
branch switching, 134
Broyden update, 139
Broyden–Fletcher–Goldfarb–Shanno update, 139
Bubnov–Galerkin approach, 192
buckling, 320
buckling load, 103
bulk modulus, 24, 269, 377
Cam-clay model, 268
Cardano’s formula, 261
central difference scheme, 144, 153
CFL criterion, 152
coaaxiality, 204, 230, 251, 264, 368, 388, 420, 422
cod blocks, 27
cohesion, 224
cohesionless soil, 268
cohesive forces, 185, 461
cohesive zone models, 185, 190, 202, 428, 456, 500
collocation methods, 444
computer aided geometric design, 473
consistency parameter, 236, 242
consistency visco-plasticity, 297
consistent mass matrix, 146, 449, 466
consistent tangent operator, 239, 249, 252, 264, 360, 421
constitutive equations, 23
constraint counting, 391
constraint equations, 444
constraint function, 119
constraint matrix, 59
constructor, 78
contact stress, 240
control net, 474, 489
control point, 474
convergence criterion, 49, 79, 136
convergence radius, 41
corotational formulation, 72, 96, 321, 397
Cossert continuum, 210
Coulomb friction, 222
couple stresses, 210
Courant–Friedrichs–Lewy criterion, 148
Cox–de Boor recursion formula, 475
crack band model, 188
crack band width, 202
crack initiation, 430, 441, 442, 461
crack propagation, 427, 441
crack propagation direction, 457
crack spacing, 209
creep function, 283
creep potential function, 288
creep strain, 287
critical time step, 146, 153, 164, 468
cross product, 7
crossed triangular elements, 273, 389
crystal plasticity, 199, 419
crystalline materials, 409
curvature, 308, 313
damage loading function, 172
damage variable, 170, 203
Damage–Plasticity Models, 270
dashpot, 281
decohesion relations, 187
deformation energy, 375
deformation gradient, 85, 107, 373, 408, 418, 460
deformation theory of plasticity, 221, 249
degenerate continuum beam element, 328, 333
degenerate continuum shell element, 343, 351
delamination, 428, 464
delta-incremental method, 48
design-through-analysis concept, 473, 490
determinant, 10, 15, 181
deviatoric strain tensor, 22
deviatoric stress tensor, 19
diffraction criterion, 447
diffuse crack pattern, 206
dilatancy angle, 220, 232
Dirac function, 181, 284, 461
director, 328, 333, 353, 357, 491
directory structure, xix
Dirichlet series, 286
discontinuity, 180, 206, 427, 452, 460, 468, 500
discontinuous Galerkin methods, 436
discontinuous pressure field, 391
discontinuous shape functions, 446
discrete crack models, 201
discrete Kirchhoff constraints, 344
dispersion relation, 159
displacement control, 50
displacement criterion, 137
distance function, 468
divergence theorem, 10, 366, 375, 436, 452, 466
domain of influence, 441, 451
drifting error, 241
Drucker’s Postulate, 230, 231
Drucker–Prager yield criterion, 228, 244, 254
ductile fracture, 187
Duvaut–Lions Visco-plasticity, 294
dyadic product, 11
dynamic instabilities, 298
dynamic residual force vector, 144, 148, 154
effective stress concept, 171, 178, 270
eigenprojection, 16, 266
eigenspectrum, 182
eigenvalue, 15, 52, 100, 103, 130, 131, 133, 136, 148, 261
eigenvector, 16, 131, 265, 388, 397
elastic compliance tensor, 23
elastic material stiffness matrix, 57
elastic stiffness tensor, 23
elasticity-based damage, 171
element connectivity, 55, 77, 489
element extraction operator, 484, 487, 489
element-free Galerkin method, 185, 442, 449
ellipticity, 179, 271
embedded discontinuity models, 190
embedded reinforcement, 207
energetically conjugate, 89, 91, 366, 397
energy criterion, 137
energy criterion for stability, 130
energy release constraint, 122, 245, 435
energy-conserving algorithms, 161
engineering beam theory, 322
engineering shear strain, 21
enhanced assumed strain approach, 191, 277, 392
enhanced strain field, 191, 343
equilibrium path, 130
equivalent strain, 173, 176
essential boundary conditions, 444, 476
Euler backward method, 241, 247, 265, 295, 360, 418
Euler coordinates, 85
Euler description, 70
Euler forward method, 239, 247
Eulerian finite element formulation, 402, 412, 461
explicit time integration, 143, 144, 150, 288, 466
exponential map integrators, 418
external force, 4
external force vector, 34, 41, 79, 143, 150
Finger deformation tensor, 87
finite rotations, 333
First Piola–Kirchhoff stress tensor, 89, 179, 367
fixed smeared crack model, 202
flow rule, 228, 413, 418
flow theory of plasticity, 221, 249
force control, 245
force criterion, 137
Fox–Goodwin scheme, 153
fracture energy, 187, 202, 209
fracture process zone, 185, 428
fragment, 25
friction coefficient, 222
Gauss elimination, 9
Gauss integration, 37, 312, 314, 318, 432, 446, 492
generalised plasticity, 242
green contribution tangential stiffness matrix, 69, 71, 74, 94, 312, 332, 340, 350
Gibbs effect, 477
gradient of the yield function, 229
Green–Nagdhi rate, 370, 413
ground-state shear modulus, 379
Hamilton–Jacobi equation, 470
hardening behaviour, 232
hardening diagram, 237
hardening modulus, 236, 237
hardening parameter, 232
harmonic perturbation, 300
Heaviside function, 181, 283, 452, 460, 467, 468
Hencky Model, 386
hierarchical integral, 285
Hermitian interpolation, 310
HHT α-method, 154
hierarchical refinement, 477
hierarchical shape functions, 309, 315
higher-order continua, 212
Hill yield criterion, 246
Hoffman yield criterion, 246
Hooke’s law, 23
Houbolt’s method, 155
hour-glass modes, 164
Hu–Washizu variational principle, 191, 313, 394
hydrostatic pressure, 19, 377
hyperelasticity, 369, 397
hypoelasticity, 371, 401
ideally elastic material, 374
Ilyushin yield function, 358
imaginary wave speed, 302
implicit time integration, 143, 153
implicit–explicit methods, 164
incompatible modes element, 276, 389, 397
incompressibility, 376, 450
incremental objectivity, 415
incremental procedure, 44
incremental-iterative procedure, 44, 46
indefinite matrix, 10
Initial Stiffness method, 49
initial strain, 284
inner product, 6
instance, 77
integration cells, 446
integration point, 37, 40
interaction stress, 209
interface, 206, 427
interface elements, 428, 453
<table>
<thead>
<tr>
<th>Term</th>
<th>Page Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>intermediate configuration</td>
<td>407</td>
</tr>
<tr>
<td>internal energy</td>
<td>22</td>
</tr>
<tr>
<td>internal force</td>
<td>4</td>
</tr>
<tr>
<td>internal force vector</td>
<td>35, 42, 69, 73, 80, 84, 96, 143, 150, 311, 315, 318, 324, 327, 349, 379, 395, 403, 462, 466</td>
</tr>
<tr>
<td>internal length scale</td>
<td>187, 211, 300</td>
</tr>
<tr>
<td>internal variable</td>
<td>170, 172, 420</td>
</tr>
<tr>
<td>internal virtual work</td>
<td>43, 90, 207, 309, 324, 327</td>
</tr>
<tr>
<td>interpolation functions</td>
<td>see shape functions, 33</td>
</tr>
<tr>
<td>invariants</td>
<td>19, 227, 261, 373</td>
</tr>
<tr>
<td>inversion of matrices</td>
<td>8</td>
</tr>
<tr>
<td>isoparametric concept</td>
<td>37, 329, 333, 490</td>
</tr>
<tr>
<td>isoparametric coordinates</td>
<td>33, 351</td>
</tr>
<tr>
<td>isotropic hardening</td>
<td>233, 244</td>
</tr>
<tr>
<td>iterative procedure</td>
<td>41</td>
</tr>
<tr>
<td>Jacobian matrix</td>
<td>37, 40, 318, 320, 403, 431</td>
</tr>
<tr>
<td>Jaumann rate</td>
<td>371, 405, 411</td>
</tr>
<tr>
<td>Karush–Kuhn–Tucker</td>
<td>172, 253, 258, 290, 296</td>
</tr>
<tr>
<td>Kelvin chain</td>
<td>286</td>
</tr>
<tr>
<td>Kelvin element</td>
<td>282</td>
</tr>
<tr>
<td>kernel</td>
<td>285</td>
</tr>
<tr>
<td>kinematic constraint</td>
<td>272</td>
</tr>
<tr>
<td>kinematic hardening</td>
<td>233, 242</td>
</tr>
<tr>
<td>Kirchhoff assumption</td>
<td>309</td>
</tr>
<tr>
<td>Kirchhoff beam element</td>
<td>318</td>
</tr>
<tr>
<td>Kirchhoff stress tensor</td>
<td>368, 388, 402, 411, 419</td>
</tr>
<tr>
<td>Kirchhoff–Love formulation</td>
<td>344, 491</td>
</tr>
<tr>
<td>knot insertion</td>
<td>477, 485, 500</td>
</tr>
<tr>
<td>knot interval</td>
<td>476, 481</td>
</tr>
<tr>
<td>knot multiplicity</td>
<td>476</td>
</tr>
<tr>
<td>knot value</td>
<td>476</td>
</tr>
<tr>
<td>knot vector</td>
<td>474, 475, 476</td>
</tr>
<tr>
<td>Koiter’s generalisation</td>
<td>253, 260, 361</td>
</tr>
<tr>
<td>Lüders bands</td>
<td>298</td>
</tr>
<tr>
<td>Ladyzenskaya–Babuška–Brezzi condition</td>
<td>391</td>
</tr>
<tr>
<td>Lagrange coordinates</td>
<td>85</td>
</tr>
<tr>
<td>Lagrange description</td>
<td>70, 86</td>
</tr>
<tr>
<td>Lagrange multipliers</td>
<td>436, 444</td>
</tr>
<tr>
<td>Lagrange polynomials</td>
<td>475, 484</td>
</tr>
<tr>
<td>Lamé constants</td>
<td>24, 284</td>
</tr>
<tr>
<td>large displacement gradients</td>
<td>63</td>
</tr>
<tr>
<td>large rotation increments</td>
<td>333</td>
</tr>
<tr>
<td>layered approach</td>
<td>346, 356</td>
</tr>
<tr>
<td>layered beam</td>
<td>313</td>
</tr>
<tr>
<td>LDU decomposition</td>
<td>9, 52, 133</td>
</tr>
<tr>
<td>left Cauchy–Green deformation tensor</td>
<td>87, 386, 410, 420</td>
</tr>
<tr>
<td>left stretch tensor</td>
<td>87, 388</td>
</tr>
<tr>
<td>level set function</td>
<td>456, 470</td>
</tr>
<tr>
<td>Lie derivative</td>
<td>410</td>
</tr>
<tr>
<td>limit point</td>
<td>117, 132, 133</td>
</tr>
<tr>
<td>line search technique</td>
<td>113, 124</td>
</tr>
<tr>
<td>linear acceleration scheme</td>
<td>153</td>
</tr>
<tr>
<td>linear buckling analysis</td>
<td>100</td>
</tr>
<tr>
<td>linear comparison solid</td>
<td>134, 180</td>
</tr>
<tr>
<td>linear contribution tangential stiffness matrix</td>
<td>69, 71, 73, 94</td>
</tr>
<tr>
<td>linear elastic fracture mechanics</td>
<td>427, 441, 447, 455</td>
</tr>
<tr>
<td>linear elasticity</td>
<td>23</td>
</tr>
<tr>
<td>Linear Multi-Step schemes</td>
<td>155</td>
</tr>
<tr>
<td>Linux distributions</td>
<td>xix</td>
</tr>
<tr>
<td>literate programming</td>
<td>xx, 25</td>
</tr>
<tr>
<td>load control</td>
<td>50</td>
</tr>
<tr>
<td>load increment</td>
<td>44</td>
</tr>
<tr>
<td>load parameter</td>
<td>44, 150</td>
</tr>
<tr>
<td>loading function</td>
<td>225</td>
</tr>
<tr>
<td>Lobatto integration</td>
<td>37, 312, 341, 432</td>
</tr>
<tr>
<td>local basis function domain</td>
<td>476</td>
</tr>
<tr>
<td>local residuals</td>
<td>241, 269, 420</td>
</tr>
<tr>
<td>local spin</td>
<td>97</td>
</tr>
<tr>
<td>localisation</td>
<td>183, 188, 196, 300, 448</td>
</tr>
<tr>
<td>location matrix</td>
<td>34</td>
</tr>
<tr>
<td>logarithmic strain tensor</td>
<td>388, 419</td>
</tr>
<tr>
<td>loss of ellipticity</td>
<td>180, 210</td>
</tr>
<tr>
<td>loss of positive definiteness</td>
<td>130, 133, 180</td>
</tr>
<tr>
<td>loss of uniqueness</td>
<td>101, 130</td>
</tr>
<tr>
<td>lumped integration</td>
<td>434</td>
</tr>
<tr>
<td>lumped mass matrix</td>
<td>146, 149, 466, 476</td>
</tr>
<tr>
<td>Lyapunov stability</td>
<td>129, 179</td>
</tr>
<tr>
<td>Mac OS X</td>
<td>xix</td>
</tr>
<tr>
<td>MacAulay brackets</td>
<td>173, 292</td>
</tr>
<tr>
<td>mass matrix</td>
<td>34, 143, 466</td>
</tr>
<tr>
<td>material coordinates</td>
<td>85, 101</td>
</tr>
<tr>
<td>material description</td>
<td>70</td>
</tr>
<tr>
<td>material stability</td>
<td>179, 182</td>
</tr>
<tr>
<td>material tangential stiffness matrix</td>
<td>43, 99, 108, 178, 398, 403, 430</td>
</tr>
<tr>
<td>Maxwell chain</td>
<td>285</td>
</tr>
<tr>
<td>Maxwell compatibility condition</td>
<td>181</td>
</tr>
<tr>
<td>Maxwell element</td>
<td>282</td>
</tr>
<tr>
<td>member function</td>
<td>77</td>
</tr>
<tr>
<td>membrane locking</td>
<td>313, 343, 356, 450</td>
</tr>
<tr>
<td>membrane strain</td>
<td>309, 313</td>
</tr>
<tr>
<td>Term</td>
<td>Page Numbers</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>mesh sensitivity</td>
<td>179, 182, 196, 271, 302, 346, 458, 496</td>
</tr>
<tr>
<td>meshfree methods</td>
<td>185, 442</td>
</tr>
<tr>
<td>meshless methods</td>
<td>442</td>
</tr>
<tr>
<td>micro-cracking</td>
<td>185</td>
</tr>
<tr>
<td>microplane model</td>
<td>199</td>
</tr>
<tr>
<td>midpoint configuration</td>
<td>417</td>
</tr>
<tr>
<td>midpoint return-mapping scheme</td>
<td>246</td>
</tr>
<tr>
<td>midpoint rule</td>
<td>288, 292</td>
</tr>
<tr>
<td>mixed finite elements</td>
<td>391</td>
</tr>
<tr>
<td>mixed hardening</td>
<td>235</td>
</tr>
<tr>
<td>mode jumping</td>
<td>124</td>
</tr>
<tr>
<td>mode-I crack</td>
<td>188</td>
</tr>
<tr>
<td>mode-II crack</td>
<td>188</td>
</tr>
<tr>
<td>modified Newton–Raphson method</td>
<td>48</td>
</tr>
<tr>
<td>Mohr’s circle</td>
<td>224</td>
</tr>
<tr>
<td>Mohr–Coulomb yield criterion</td>
<td>224, 260, 386</td>
</tr>
<tr>
<td>moment of inertia</td>
<td>311</td>
</tr>
<tr>
<td>monomials</td>
<td>443</td>
</tr>
<tr>
<td>Mooney–Rivlin model</td>
<td>378</td>
</tr>
<tr>
<td>moving least squares approximation</td>
<td>442</td>
</tr>
<tr>
<td>multi-surface plasticity</td>
<td>252</td>
</tr>
<tr>
<td>multilaminate model</td>
<td>199</td>
</tr>
<tr>
<td>multiplicative elasto-plastic decomposition</td>
<td>402, 407, 418, 419</td>
</tr>
<tr>
<td>Nanson’s formula</td>
<td>366, 461</td>
</tr>
<tr>
<td>near-incompressibility</td>
<td>376</td>
</tr>
<tr>
<td>neo-Hookean model</td>
<td>378</td>
</tr>
<tr>
<td>nested yield surfaces</td>
<td>235</td>
</tr>
<tr>
<td>neutral equilibrium</td>
<td>130</td>
</tr>
<tr>
<td>Newmark time integration</td>
<td>153</td>
</tr>
<tr>
<td>Newton–Cotes integration</td>
<td>37, 312, 341, 432</td>
</tr>
<tr>
<td>nodal integration</td>
<td>446</td>
</tr>
<tr>
<td>nominal stress tensor</td>
<td>366</td>
</tr>
<tr>
<td>nominal traction</td>
<td>89, 91, 366</td>
</tr>
<tr>
<td>non-associated flow rule</td>
<td>197, 230, 251</td>
</tr>
<tr>
<td>non-associated hardening</td>
<td>251, 269</td>
</tr>
<tr>
<td>non-convex domain</td>
<td>446</td>
</tr>
<tr>
<td>non-linear elasticity</td>
<td>268</td>
</tr>
<tr>
<td>non-local damage models</td>
<td>210</td>
</tr>
<tr>
<td>non-local strain</td>
<td>210</td>
</tr>
<tr>
<td>non-negativity property</td>
<td>476</td>
</tr>
<tr>
<td>normal force</td>
<td>309, 312, 319, 346</td>
</tr>
<tr>
<td>normal path method</td>
<td>120</td>
</tr>
<tr>
<td>normal stress</td>
<td>17</td>
</tr>
<tr>
<td>normalised external load vector</td>
<td>44</td>
</tr>
<tr>
<td>normality rule</td>
<td>230</td>
</tr>
<tr>
<td>normally consolidated soil</td>
<td>267</td>
</tr>
<tr>
<td>numerical dissipation</td>
<td>154</td>
</tr>
<tr>
<td>numerical integration</td>
<td>35, 38, 61</td>
</tr>
<tr>
<td>numerical stability</td>
<td>438</td>
</tr>
<tr>
<td>NURBS</td>
<td>478</td>
</tr>
<tr>
<td>objective derivative of a vector</td>
<td>369</td>
</tr>
<tr>
<td>objective stress rate</td>
<td>370, 403</td>
</tr>
<tr>
<td>Ogden model</td>
<td>383</td>
</tr>
<tr>
<td>order elevation</td>
<td>477</td>
</tr>
<tr>
<td>orthogonal matrix</td>
<td>13</td>
</tr>
<tr>
<td>out-of-balance vector</td>
<td>45</td>
</tr>
<tr>
<td>out-of-plane shear strains</td>
<td>345</td>
</tr>
<tr>
<td>overconsolidated soil</td>
<td>268</td>
</tr>
<tr>
<td>overstress plasticity</td>
<td>296</td>
</tr>
<tr>
<td>parameter domain</td>
<td>474</td>
</tr>
<tr>
<td>Park’s method</td>
<td>155</td>
</tr>
<tr>
<td>partition-of-unity property</td>
<td>451, 476</td>
</tr>
<tr>
<td>partitioned procedure</td>
<td>117</td>
</tr>
<tr>
<td>patch test</td>
<td>53</td>
</tr>
<tr>
<td>path length</td>
<td>116</td>
</tr>
<tr>
<td>path-following constraint</td>
<td>116</td>
</tr>
<tr>
<td>path-following method</td>
<td>116, 245</td>
</tr>
<tr>
<td>penalty functions</td>
<td>445</td>
</tr>
<tr>
<td>perfect bond</td>
<td>206</td>
</tr>
<tr>
<td>perfectly brittle material</td>
<td>169, 185, 202</td>
</tr>
<tr>
<td>Perzyna visco-plasticity</td>
<td>292</td>
</tr>
<tr>
<td>Petrov–Galerkin approach</td>
<td>196, 442</td>
</tr>
<tr>
<td>physical domain</td>
<td>474</td>
</tr>
<tr>
<td>pivot</td>
<td>9, 133</td>
</tr>
<tr>
<td>plane acceleration waves</td>
<td>181</td>
</tr>
<tr>
<td>plane-strain consistent relation</td>
<td>109</td>
</tr>
<tr>
<td>plane-strain damage consistent relation</td>
<td>175</td>
</tr>
<tr>
<td>plastic dilatancy</td>
<td>231</td>
</tr>
<tr>
<td>plastic flow direction</td>
<td>229</td>
</tr>
<tr>
<td>plastic potential function</td>
<td>230</td>
</tr>
<tr>
<td>plastic spin tensor</td>
<td>410, 418</td>
</tr>
<tr>
<td>plastic stretching</td>
<td>409, 418</td>
</tr>
<tr>
<td>plastic volume change</td>
<td>231</td>
</tr>
<tr>
<td>point interface elements</td>
<td>434</td>
</tr>
<tr>
<td>Poisson effect</td>
<td>203</td>
</tr>
<tr>
<td>Poisson’s ratio</td>
<td>23, 57, 172, 175, 284</td>
</tr>
<tr>
<td>polar decomposition</td>
<td>86, 368</td>
</tr>
<tr>
<td>Portevin–Le Chatelier bands</td>
<td>298</td>
</tr>
<tr>
<td>positive definite matrix</td>
<td>10, 476</td>
</tr>
<tr>
<td>potential energy</td>
<td>375</td>
</tr>
<tr>
<td>Prager’s consistency condition</td>
<td>228, 413</td>
</tr>
<tr>
<td>Prager’s hardening rule</td>
<td>234</td>
</tr>
</tbody>
</table>
preconsolidation pressure, 268
predictor, 127
prescribed displacements, 56
prestressed concrete, 206
principal stretches, 373, 388, 422
principal value, 15, 261, 372
principle of objectivity, 369
principal value, 15, 261, 372
principle of virtual work, 33, 64, 98, 272, 314, 349, 402
projection matrix, 228, 244, 255
projection vector, 228, 256
propagating discontinuities, 469, 504
propagative instabilities, 298
pseudo-load vector, 281, 293
PyFEM.py, xix, 125
Python, xix, 41
Python database, 77
quadratic convergence, 50
quadrilateral element, 40
quarter-point elements, 441
quasi-brittle fracture, 187
Quasi-Newton Methods, 50, 138, 258
quaternions, 418
radial return method, 249
radius of convergence, 50, 113
Rankine yield criterion, 254
rate of deformation tensor, 370, 403
Rayleigh coefficient, 148
reduced integration, 164, 275, 343, 389
reference frame, 5, 12, 19
rehardening, 298
reinforced concrete, 206
Reissner–Mindlin formulation, 344, 491
relative displacements, 428
relaxation function, 283
relaxation time, 282, 290, 295
remeshing, 428, 441
residual vector, 45, 81, 294, 311
return-mapping algorithm, 239, 240, 269, 297, 417
Riemann integral, 283
right Cauchy–Green deformation tensor, 86, 372, 408
right stretch tensor, 86, 368, 397
Riks’ method, 120, 125
rotating crack model, 203, 205, 265, 266, 386
rotation matrix, 13, 334
Routh–Hurwitz stability theorem, 300
rubbers, 374
Runge–Kutta methods, 156
Secant-Newton methods, 50
second Piola–Kirchhoff stress, 108
second-order accuracy, 144, 153
see-through criterion, 447
selective integration, 275
shallow-arch formulation, 344
shape functions, 33, 38, 39, 57, 151, 309, 325, 329, 336, 348, 352, 393, 430, 442, 443, 451, 476, 488
shear band, 190, 196, 298
shear correction factor, 316, 354
shear deformation, 314, 326
shear force, 314, 316, 346
shear locking, 316, 343, 348, 356, 450
shear modulus, 24
shear retention factor, 202
shear strain, 21, 314
shear stress, 17
Sherman–Morrison formula, 10, 139
Simpson integration, 37, 312, 341
single-edge notched beam, 196, 214, 428, 504
singular matrix, 9, 15
slip theory, 199
slope stability, 245
small-scale yielding, 185
smeared crack models, 189, 201
snap-back behaviour, 117
softening modulus, 183, 197
solid-like shell elements, 344, 356
spatial coordinates, 85, 101
spatial description, 70
spectral decomposition, 16, 245, 257, 409, 422
spectral radius, 52
spherical arc-length constraint, 119
spin tensor, 370
splines, 473
spring–sliding system, 219
spurious cracking, 206
spurious kinematic modes, 164, 274
spurious wave reflections, 432, 454
stabilised crack pattern, 209
stabilised finite element method, 395
stability, 179, 299
stability of the integration scheme, 241, 249, 260, 293
stable equilibrium, 130
static condensation, 194
Stieltjes integral, 283
strain energy density, 374
strain energy function, 376, 388, 411
strain history, 284
strain softening, 157, 179, 301
strain tensor, 21
strain-hardening creep, 288
strain-hardening hypothesis, 233
strain-rate softening, 297
stress history, 284
stress intensity factor, 427
stress resultants, 309, 343
stress singularity, 447, 455, 457
stress tensor, 17
stress vector, 17, 18
stress-dependent elastic moduli, 268
stress-resultant shell elements, 343
stress–strain relations, 23
stretching tensor, 370
strong discontinuity, 190
structural stability, 100, 180, 320, 464
subcycling, 164
subincrements, 249
sublayer model, 235
subspace constraint equation, 122
superposition principle, 283
support, 441, 446, 450, 476

T-junction, 481
T-mesh, 481
T-spline control mesh, 481
T-splines, 480
tangent cutting plane algorithm, 247
tangential shear modulus, 316, 348
tangential stiffness matrix, 10, 44, 48, 51, 58, 80, 82, 100, 130, 131, 136, 144, 150, 154, 163, 174, 198, 210, 288, 293, 295, 297, 311, 327, 332, 349, 379, 385, 395, 403, 411, 430, 453, 462
tangential stiffness modulus, 5, 65, 312
tension softening, 202, 208
tension stiffening, 208
tensorial shear strain, 21
test functions, 196, 365, 436, 442, 465
thickness stretching, 356
through-the-depth integration, 312, 343
time step selection, 164
time-discontinuous Galerkin methods, 156
time-hardening creep, 288
Timoshenko beam, 314, 326
Total Lagrange formulation, 67, 96, 161
total stress–strain relation, 171, 174
total-incremental method, 46
trace, 12, 377
traction oscillations, 431, 454
transformation of a second-order tensor, 13, 22
transformation of a vector, 12
transpose of a matrix, 8
trapezoidal return-mapping scheme, 245
trapezoidal rule, 153, 288, 291
Tresca yield criterion, 226, 260
trial functions, 196, 394
trial stress, 240, 258, 360
Truesdell rate, 371, 403, 411, 461
truss element, 64, 81
two-stage solution procedure, 117
unconditional stability, 153, 156
unstructured meshes, 463
Updated Lagrange formulation, 70, 96
updated normal path method, 120
variation diminishing property, 477
variational inconsistency, 196
velocity gradient, 179, 370, 409
Vieta’s rule, 15, 130
visco-plastic strain, 289
viscosity, 282, 290
visibility criterion, 447
void initiation, 185
Voigt notation, 18
volumetric hardening, 233, 267
volumetric locking, 271, 389, 450
volumetric strain, 22
von Mises yield criterion, 227
wave dispersion, 156
wave length, 300
wave number, 300
weak discontinuity, 190, 469
weak formulation, 33, 190
weight factor, 320
weight function, 210, 443
well-posedness, 181, 210
Windows, xix

work of separation, 187
work-hardening hypothesis, 232

yield function, 225, 412
Young’s modulus, 4, 23, 57, 65, 175, 198, 237, 282, 284, 469

zero-energy modes, 164
Ziegler’s hardening rule, 234