3D DIC systems, 158 cost function, 153 cubic element, 77 4f system, 128–129 D active stabilization, 69 defect detection, 56 Airy disc, 18 deformation, 76 atmospheric conditions, 62 derivatives of surface displacements, averaged intensity, 27 52 design process, 1 deterministic component, 20 B difference of phases, 32 Barkhausen noise, 126 "bathtub" failure-probability differential method, 152 diffraction angle, 49 bending deflection method, 101 diffraction gratings, 49, 129 bending moment, 117 diffractive optical elements bending stress, 117 (DOEs), 49 Bessel functions, 57 digital image correlation (DIC), binary profile, 49 151 blind hole-drilling method, 89 digital speckle pattern branch-cut algorithms, 36 interferometry (DSPI), 14 branch cuts, 35 digital speckle shearing "butterfly" pattern, 138 interferometry, 52 diode laser, 50 \mathbf{C} dipoles, 35 Carré, 30 discontinuity sources, 35 clamping system, 96 dumping element, 69 combined stress, 115, 119 dynamic measurements, 57 compact design, 67 complex amplitude, 16 \mathbf{E} composite materials, 56 eddy-current methods, 126 conical mirror, 46-49, 140 elastic legs, 91 Constantan, 80 electronic speckle pattern correlation fringes, 25 interferometry (ESPI), 14

environmental isolation, 68 excitation, 133

F

failure, 3
Faraday cage, 69
five-frame algorithm, 29
flaw, 133
four-frame algorithm, 29
four-point bending configuration, 93
Fourier approach, 86
fringe equation, 49–50
fringe visibility, 27
full-field techniques, 136

G

grating (moiré) interferometry, 82

Н

harmonic, 86 harsh agents, 62 harsh environment, 61 hole-drilling method, 101 Hooke's law, 78 Hungarian algorithm, 35 Huygens' principle, 14

T

in-plane, 57 in-plane polarization, 58 in-plane sensitivity, 44, 82 indentation, 104, 113 "infant mortality," 6 interferometric techniques, 151 in situ applications, 120 iterative methods, 153

\mathbf{L}

large inspection area, 135 least-squares method, 86–87, 118 Liberty Bell, 99 liquid-penetrant inspection, 126 loading module, 136 long-term stability, 67 longitudinal stress, 117 Lucas–Kanade tracker algorithm, 153

M

macroscopic residual stress, 100 magnetic method, 101, 126 matching method, 153 matching process, 154 measurement of derivatives, 58 mechanical loading, 133 mechanical stress, 75 mechanical stress field, 86 Michelson configuration, 54 Michelson interferometer, 128 mobile shearographic setup, 142 modulation intensity, 27 modulus of elasticity in shear, 78 modulus of rigidity See modulus of elasticity in shear monolithic construction, 70, 72 Mozorov criterion, 104 multiple cameras, 159

N

neutron diffraction method, 101 nondestructive techniques, 125 nondestructive testing (NDT), 56, 58 noninterferometric techniques, 151 nonuniform residual stress, 102 norm minimization, 36 normal failures, 6 normal stress, 78 normalized sum of square difference (NSSD), 154

О

objective speckle, 17 optical flow, 152 optical path difference (OPD), 24

optical phase, 20 \mathbf{S} optical phase distribution, 51 safety coefficients, 4 optical techniques, 8, 82 scattering surface, 20 optically rough, 14 sectioning method, 101 out-of-plane displacements, 160 sensitivity vector, 21, 55 out-of-plane sensitivity, 41, 82 service life, 3 service loads, 4 P shape function, 153 period of the grating, 50 shear direction, 56 phase difference, 24 shearing effect, 53 phase discontinuities, 34 shearing stress, 78 phase of differences, 32 shearography, 8, 52, 56, 127, phase unwrapping, 32 143 phase-shifting algorithm, 48, 51 shock, 62 phase-shifting method, 104 spatial phase shifting, 28 phase-shifting techniques, 43 spatial phase unwrapping, 33 phase-unwrapping algorithm, 104 speckle decorrelation, 24 piezoelectric actuator, 43 speckle distribution, 13, 15 piezoelectric translator (PZT), 30, speckle size, 17–18 specklegram, 23 Poisson coefficient, 78 stereovision, 156, 160–161 Poisson ratio, 85 stereovision system, 156 polarization discrimination storage tank, 140 methods, 45 strain, 75-76 strain gage, 79 R strain-gage rosettes, 102 radial in-plane displacement field, structural health monitoring, 167 48, 86 subjective speckles, 19 radial in-plane interferometer, 47, submicroscopic residual stress, 100 subset function, 153 radial in-plane sensitivity, 46–47 sum of squares deviation (SSD), 153 radiation, 62 radiation isolation, 69 T radiographic techniques, 125 Taylor series, 56 random component, 20 temperature isolation, 68 random walk, 16 temporal phase shifting, 28 relative phase, 23 temporal phase unwrapping, 33 residual stress, 99, 116 thermal loading, 132, 137, 140 residues, 35 thermal stress, 116 resistivity, 80 thermography, 127, 143 rigid-body displacement, 91 three sensitivity directions, 82 rigid-body motion, 76 time-averaged techniques, 57 rigid-body translations, 86 triangulation, 159 Robert Hooke, 75 two-beam illumination, 44

U

U-body, 93 ultrasonic method, 101 ultrasonic techniques, 126 uncooperative material, 135 uniform stresses, 102

V

vacuum chamber, 132 vacuum loading, 132 vacuum window, 142 variation in the phase difference, 25 vibration, 62, 133 vibration isolation, 69 visual inspection, 125 volumetric digital image correlation (VDIC), 159

W

wave-propagation vectors, 21 wedge, 52

weighting factors, 36 Wheatstone bridge, 81 white-light sources, 155 working conditions, 4 wrapped difference phase map, 33 wrapping operator, 31

X

x rays, 125 x-ray computed tomography, 126 x-ray diffraction method, 101

Y

Young modulus, 85

\mathbf{Z}

zero-mean sum of square difference (ZSSD), 154



Matias R. Viotti is an Associate Researcher in the Mechanical Engineering Department of the National University of Santa Catarina, Brazil. He works at the Metrology and Automatization Laboratory (Labmetro), which is linked to the university. He is a senior member of SPIE and a member of OSA. He has co-authored more than 50 papers published in international journals and conference proceedings, and one book chapter.



Armando Albertazzi, Jr. is a Professor of Mechanical Engineering at the National University of Santa Catarina, Brazil. He is the head of the Metrology and Automatization Laboratory (Labmetro), which is linked to the university. He is a fellow of SPIE and a member of OSA and SEM. Prof. Albertazzi has co-authored more than 150 papers published in international journals and conference proceedings, and several book chapters.