

- active clothing 234
- actuating fabrics 67–71, 181–2
 - carbon nanotube fibre actuators 71
 - conducting polymer fibre actuators 70–1
 - dielectric elastomer wearable actuators 68–70
- actuator polymers 70–1, 240
- affective computing 226
- American Sign Language 76
- Anderson localisation 141
- antennas 238
- applications
 - of communication apparel 159
 - of electroceramic fibres 54–5
 - for flexible displays 171–2
 - in multimedia 75–6
 - of smart textiles 124–33
 - of wearable electronics 8–10, 101–2
- arctic clothing 179
 - Reima survival suit 216–18
- audio interfaces 3

- bending of optical fibres 111–15, 116–19
- Berry numbers 17–18
- biometric sensing 238
- biphasic fibres 164–5
- block-based technology 2
- Bluetooth 5, 211–13
- body movement detection 72–4
- bonded structures 110
- Bragg grating structure 124–5, 136–7, 139

- cables and wiring 5, 119, 205, 217–18
- cameras 1–2
- carbon black 29

- carbon fibres 83
- carbon loaded rubber (CLR) sensors 63, 65–7
- carbon nanotubes 29, 71
- central processing units (CPUs) 183, 201
- ceramic fibres
 - applications in intelligent apparel 54–5
 - epoxy 1-3 composites 45–9
 - parallel and series model 49–54
 - polymer 1-3 composites 49–54
 - PT (lead titanate) 42–5
 - PZT (lead zirconate titanate) 41, 42–5
- chameleon fibres 164
- chemoresistivity 61
- CLCs (cholesteric liquid crystals) 144
- clothing 9–10, 178–9
 - active clothing 234
 - colours 233, 238
 - concept 232–4
 - and creativity 235–6
 - psychophysics 232–3
 - and social interaction 234–5
 - see also* communication apparel; smart clothing
- CLR (carbon loaded rubber) sensors 63, 65–7
- coating of nanofibres 33–4
- coherent backscattering 141
- colour sources 136, 138
- colours of clothing 233, 238
- communication apparel 155–74
 - applications 159
 - automatic functioning 158
 - connection problems 162–3
 - data processing 162
 - design 160
 - displays 161–2, 163–73
 - electronic parts 160

- energy sources 162, 163
- interfaces 160–2
- manual functioning 158
- peripherals 160–2
- sensors 161
- communication technologies 4–5, 8
 - infrared communication 212–13
 - radio frequency (RF) systems 213–14
 - remote interpersonal tools 232–4
 - requirements in smart clothing 202–3, 204
- computing systems
 - affective computing 226
 - interaction design 226
 - pervasive computing 225
 - ubiquitous computing 224–5
 - wearable computing 177–8, 198, 214–16, 225
 - see also* electronic textiles
- concept model 199–200
- conducting polymer fibre actuators 70–1
- conductive carbon fibres 83
- conductive fabrics and fibres 7–8, 13–14, 81, 164, 205–7, 237–8
 - electromechanical properties 81, 82–4
 - shielding 205–6
 - see also* smart clothing; smart textiles
- conductive polymer coatings 83
- connections 162–3, 205, 206–7
- copper wires *see* wiring and cables
- cotton fabrics 63–7
- CPU (central processing unit) 183, 201
- creativity 235–6
- crosstalk 194
- cultural implications 10–11, 226

- DARPA 177
- data management technologies 5–6
- data processing 162
- data transfer 202–14
 - cables 205, 217–18
 - communication model for smart clothing 202–3
 - connectors 205, 206–7
 - electrically conductive fibres 205–7
 - external 208–9
 - internal 210–14
 - personal space 210–14
- requirements 203
 - wired 203–7
 - wireless 207–10, 238
- design processes 160, 231–2
- development of technology 1, 223–40
- diameter of fibres 14–15, 16–19
- dielectric constant 34–7
- dielectric elastomer wearable actuators 68–70
- display matrix design 166–71
- display technologies 4
 - in communication apparel 161–2, 163–73
 - fibre-harvesting ambient light-reflective 138–40
 - flat panels 150
 - flexible displays 151, 164–72
 - optical fibre (OFFD) 165–71
 - reflective displays 139–40
 - side-emitting fabrics 151
 - textile-based 151, 164–5
- dye molecules 143

- E-broidery project 181
- E-Ink 239
- economic implications 10
- electric wiring and cables 5, 119, 205, 217–18
- electroactive fabrics 59–79
 - actuating fabrics 67–71, 181–2
 - for health care 71
 - as kinaesthetic interfaces 76–9
 - for motion capture 71–6
 - multimedia applications 75–6
 - sensing fabrics 62–7
 - see also* smart textiles
- electroactive nanofibres 21–34
- electroactive polymers 182, 239–40
- electroceramic fibres 41–55
 - applications in intelligent apparel 54–5
 - ceramic fibre/epoxy 1-3 composites 45–9
 - ceramic fibre/polymer 1-3 composites 49–54
 - parallel and series model 49–54
 - PT (lead titanate) fibres 42–5
 - PZT (lead zirconate titanate) fibres 41, 42–5

- electrodeless coatings 33–4, 84
- electrokinetic polymers 61
- electroluminescent fibres and fabrics 145–51
- electromagnetic interference (EMI) shielding 82, 180
- electromechanical properties 81–102
 - of ceramic fibre/epoxy 1-3 composites 49
 - of conductive textiles 81, 82–4
 - of PPy-coated conductive fibres/yarns 84–99
 - of stainless steel fabric 99–101
- electromechano-chemical polymers 62
- electronic ink 239
- electronic polymers 4
- electronic textiles 179–84
 - actuators 181–2
 - networks 180–1, 184–94
 - power supply 183
 - processors 183
 - sensors 181–2
 - signal transmission 186–94
- electrospinning 15–21, 38
 - Berry numbers 17–18
 - diameter of fibres 14–15, 16–19
 - rotary electrospinning 19–20
 - of self-assembled yarn 20–1
 - stretching process 15–16
 - yarn and fabric formation 19–21
- electrostatically generated nanofibres 13–38
 - coating of nanofibres 33–4
 - electroactive nanofibres 21–34
 - electrospinning 15–21
 - nanocomposites 29–33
 - pyrolysis of nanofibres 33–4
 - ultra-low dielectric constant nanocomposite film 34–7
- electrostatics 62
- electrostriction 62
- embedded intelligence 228, 229
- embedded wiring 5
- EMI shielding 82, 180
- energy management technologies 6–7
- energy sources 6–7, 162, 163, 183, 202, 239–40
- epoxy 1-3 composites 45–9
- ESBG (electrically switchable Bragg grating) 139–40
- Experience Economy* 227
- external data transfer 208–9
- fabric-based displays 163–73
- fabric-based interfaces 3
- fabric-based sensors 3
- fashion applications 9–10
- FBG sensor 124–5
- fibre-based technology 2, 106, 107
 - see also* optical fibres
- fibre-harvesting ambient light-reflective displays 138–40
- flat panel displays 150
- flexible displays 171–2
 - applications 171–2
 - optical fibre flexible displays (OFFDs) 165–71
 - textile-based 151, 164–5
 - see also* display technologies
- flexible substrates 150
- FOLEDs (flexible organic light emitting devices) 145–51
- France Telecom 182
- frequency characterisation 192–3
- fuel cells 6
- gaming 235–6
- Gershenfield, N. 227, 230
- Gilmore, James 227
- Gore-Seam® shielding 206
- graphite nanoplatelets 29
- GSM systems 4–5, 208–9
- healthcare 8–9, 11–12, 71
 - monitoring shirts 124
 - smart fabrics for 71
 - telesurgery 76
- heat generation 238
- heating jacket 218–19
- hierarchy of needs 226–7
- HIPERLAN 210
- home applications 9–10
- HPDLC (holographic polymer dispersed liquid crystal) screens 4, 139–40
- human–computer interaction design 226

- ICD+ 2
 ICPs (intrinsically conductive polymers)
 14, 21–9, 37
 impedance measurement 188–90
 impedance simulation 190–2
 implementation model 200–2
 implications of wearable technology
 10–12
 industrial applications 10
 Industrial Clothing Design Plus 2
 infrared communication 212–13
 inks 84, 239
 input interfaces 3
 integrated circuits 7–8
 integrating machinery 110–11
 integrating optical fibres 119–24
 intelligent apparel *see* smart clothing
 interaction design 226
 interfaces 2–4, 160–2
 kinaesthetic interfaces 76–9
 in smart clothing 201–2
 interference effects 138, 141
 internal data transfer 210–14
 interpersonal communication tools
 232–4
 iridescent films and fibres 138
 ISM bands 210–11
- joysticks 76
- K materials 34–5, 38
 kinaesthetic interfaces 76–9
 kinetic energy 6
 knitted structures 99–101, 107–8, 122
 knitting machines 115
 knowledge age 224–6
- Lawandy model 143–4
 layers of clothing 199–200
 LCD (liquid crystal display) screens 4
 lead titanate (PT) fibres 42–5
 lead zirconate titanate (PZT) fibres 41,
 42–5
 LEDs (light emitting diodes) 169, 182,
 239
 leisure applications 9–10
 Lifeshirt 179
 light emitting diodes (LEDs) 169, 182,
 239
- light generation 136
 long-range communications 4–5
 Lycra fabrics 63–7
- machinery for integrating optical fibres
 110–11
 McKibben effect 69
 magnetic storage systems 5–6
 magnetoresistivity 61
 magnetostriction 61
 Mann, Steven 225
 manufacturing smart textiles 115–24
 Maslow's hierarchy of needs 226–7
 material properties 187
 medical applications *see* healthcare
 metal fibres 83
 metallic coated fibres 83
 metallic nanoparticles 29
 military applications 10
 modified parallel and series model
 49–54
 Morpho butterflies 138
 motion capture 71–6
 body movement detection 72–4
 MP3 players 2
 MPD (modal power distribution) sensors
 125–9, 131
 Multi-Fibre Arrangement 223
 multimedia applications 75–6
- nanocomposites 29–33
 nanofibres
 coating 33–4
 electroactive 21–34
 electrospinning 15–21
 manufacturing methods 15
 pyrolysis 33–4
 ultra-low dielectric constant
 nanocomposite film 34–7
 nanotechnology 240
 networks 180–1, 184–94
 electrical characterisation 186–94
 geometry of textiles 184–6
 Newton–Raphson iteration 112
 non-woven structures 110, 116
- OLEDs (organic light emitting devices)
 145–51

- Olofsson model 114
- optical fibres 106, 107–9, 116–19, 165, 180
- bending of fibres 111–15, 116–19
 - display matrix design 166–71
 - fabric displays 163–73
 - FBG sensor 124–5
 - flexible displays (OFFD) 165–71
 - integrating 110–11, 119–24
 - side-emitting displays 151
 - for transmitting light 139
 - weaving 166
- optical storage systems 6
- opto-amplification 140–5
- organic light emitting devices (OLEDs) 145–51
- orthogonal interlace calculations 112–15
- output interfaces 3–4
- PAN (personal area networks) 5
- parachutes 124–33
- parallel and series model 49–54
- PBGs 136–8, 144–5
- Peirce geometrical model 112, 114
- peripherals in communication apparel 160–2
- personal position manager (PPM) 19–20
- personal space communication 202–3
- personal space data transfer 210–14
- pervasive computing 225
- Philips jacket 179
- photoconductivity 61
- photoelectricity 61
- photonic band-gap materials (PBGs) 136–8, 144–5
- photonics 136–52
- electroluminescent fibres and fabrics 145–51
 - fibre-harvesting ambient light-reflective displays 138–40
 - opto-amplification 140–5
 - textile-based flexible displays 151
- Picard, Roz 226
- piezoelectric materials 6–7, 41
- piezoelectricity polymers 61, 62
- piezoresistivity 61
- Pine, Joseph 227
- plain weave yarns 108–9
- PLEDs (polymer light-emitting diodes) 4
- polyaniline fibres 16, 21–9
- polymers
- actuator polymers 70–1, 240
 - ceramic fibre/polymer 1-3 composites 49–54
 - conductive coatings 83
 - electroactive 182, 239–40
 - electromechano-chemical 62
 - ICPs (intrinsically conductive polymers) 14, 21–9, 37
 - PLEDs (polymer light-emitting diodes) 4
 - for sensing applications 60, 61–2
 - see also* PPy
- position manager (PPM) 19–20
- power supplies 6–7, 162, 163, 183, 202, 239–40
- PPM (personal position manager) 19–20
- PPy sensors 62, 63–5
- PPy-coated conductive fibres/yarns 62, 63–5, 81–2, 84–99
- performance under strain 93–5
 - performance under tension 87–93, 95–9
- processors 183, 201
- psychophysics 232–3
- PT (lead titanate) fibres 42–5
- pyroelectricity 61
- pyrolysis of nanofibres 33–4
- PZT (lead zirconate titanate) fibres 41, 42–5
- radio frequency (RF) systems 213–14
- reflective displays 139–40
- Reima survival suit 216–18
- remote interpersonal communication tools 232–4
- rotary electrospinning 19–20
- satin weave yarns 109
- self-assembled yarn 20–1
- semi-conductive textiles 81
- sensing fabrics 62–7
- sensors 2–3, 181–2, 237–8
- biometric sensing 238
 - body movement detection 72–4
 - CLR (carbon loaded rubber) 63, 65–7

- and communication apparel 161
- FBG sensor 124–5
- fibre optic sensors 106, 107
- MPD (modal power distribution) 125–9, 131
- polymers for sensor design 60, 61–2
- PPy sensors 62, 63–5
- sensing fabrics 62–7
- SOFTswitch 182
- temperature sensors 218–19
- WearNET 179
- see also* smart textiles
- shielding conductive fibres 82, 180, 205–6
- short message service (SMS) 208
- short-range communications 5
- side-emitting displays 151
- sign language 76
- signal integrity 194
- signal transformations 181–2
- signal transmission 186–94, 238
 - crosstalk 194
 - frequency characterisation 192–3
 - impedance measurement 188–90
 - impedance simulation 190–2
 - material properties 187
 - signal integrity 194
 - transmission line configuration 187–8
- silicon chips 7
- silicone rubbers 68
- single-wall carbon nanotubes (SWNTs) 29–33
- smart clothing 9–10, 158–9, 198–202
 - central processing unit (CPU) 201
 - communication requirements 202–3, 204
 - concept model 199–200
 - electroceramic fibres 54–5
 - health monitoring shirts 124
 - heating jacket 218–19
 - implementation model 200–2
 - layers 199–200
 - power management 202
 - survival suits 179, 216–18
 - uniforms 124
 - user interfaces 201–2
 - see also* clothing; communication apparel; data transfer
- smart parachutes 124–33
- smart textiles 105–6, 107–11
 - applications 124–33
 - bending of optical fibres 111–15
 - for healthcare 71
 - integrating optical fibres 119–24
 - machinery used 110–11
 - intelligent apparel 158–9
 - as kinaesthetic interfaces 76–9
 - knitted structures 99–101, 107–8, 122
 - manufacturing 115–24
 - for motion capture 71–6
 - non-woven structures 110, 116
 - woven structures 109, 122
- Smart Textiles Network 228–9
- SMS (short message service) 208
- social implications 10–11, 234–5
- SOFTswitch 182
- sol-gel process 41, 45
- solid-state storage systems 6
- stainless steel fabric 99–101
- storage technologies 5–6
- stretching process 15–16
- survival suit 179, 216–18
- SWNTs (single-wall carbon nanotubes) 29–33
- technological development 1, 223–40
- telecommunications 171
- telesurgery 76
- temperature sensors 218–19
- template method 15
- textile geometry 184–6
- textile networks *see* networks
- textile-based flexible displays 151, 164–5
- textiles industry 223
- thermoelectricity 61
- thermoresistivity 61
- transformation of signals 181–2
- transmission line configuration 187–8
- twill weave yarns 109
- ubiquitous computing 224–5
- ultra-low dielectric constant
 - nanocomposite film 34–7
- underwear layer 199–200
- uniforms 124
- user interfaces *see* interfaces

- vibration interfaces 3
- video games 76
- visual interfaces 4
- voice synthesis 3–4
- VSSP (viscous suspension spinning process) 41

- weak localisation 141
- wearable computing 177–8, 198, 214–16, 225
- wearable electronics 8–10, 101–2
- Wearable Motherboard 182
- WearNET 179
- weaving machines 115–16
- weaving optical fibres 166
- web formation structures 110

- Weiser, Mark 224
- wired data transfer 203–7
- wireless data transfer 207–10, 238
- wiring and cables 5, 119, 205, 217–18
- WLAN (wireless local area networks) 209–10
- woven structures 109, 122
- WPAN (wireless personal area networks) 211–12
- wrist devices 1–2

- Xerogel film 34–5

- yarn and fabric formation 19–21
- Yo-Yo 201