

Index

a

Access to radiology information (ARI) 148
 ACR-NEMA and DICOM 127–128
 ACR-NEMA 2.0 version 128
 ActiveX 127, 184
 Acute intracranial hemorrhage (AIH)
 CAD–PACS integration 452–456
 CAD system development
 acceptance testing within clinical
 environment 451–452
 difficult cases 441, 444
 extract candidates 439–441
 knowledge-based classification 441–443
 localization of AIH candidates 440–441
 realignment of the image 437–439
 segmentation of the brain 436–437
 training and validation 441, 443, 445
 clinical aspects 435–436
 clinical evaluation 451–453
 evaluation of CAD
 change of diagnostic decision 449–450
 clinicians improved
 performance 447–449
 on CT 450
 integration CAD with PACS 450
 rationale of 443, 445
 sensitivity, specificity, positive and
 negative predictive values 449
 AIH. *See* Acute intracranial hemorrhage (AIH)
 American College of Radiology (ACR) 127
 American National Standards Institute/
 International Standards Organization
 (ANSI/ISO) 115
 American Standard Code for Information
 Interchange (ASCII) 101

Analysis workstation 261–262
 Anatomic pathology workflow (PWF) 145
 Antepartum Care Summary (APS) 147
 Application layer, MIDG 353–355
 Application servers 98, 100
 ASCII text representation 102
 “Association request and response”
 commands 137
 Asynchronous transfer mode (ATM)
 technology 17, 100, 114, 115
 Audit Trail and Node Authentication
 (ATNA) 146, 148
 AURORA 3-D dedicated breast MRI
 images 240
 Automatic computerized transverse axial
 (ACTA) scanner 8–9
 Automatic image data recovery scheme, for
 DICOM conformance device
 basis 162
 general processing flow diagram 162–163
 missing images and data 162
 missing series/image recovery 164
 missing study, recovery of 163–164
 Average bone age of child
 bone age assessment 464
 computer-aided diagnosis 464–466

b

BAA DICOM structured reporting 494–495
 Backup archive server 400
 data recovery procedure 403
 functions of 401
 using application service provider model
 general architecture 402
 short-term fault-tolerant 402

- Basic patient privacy consents (BPPC) 147
 - Berkeley Software Distribution (BSD) 152
 - Big data
 - and cloud computing 575–576
 - features 577, 578
 - in DICOM PACS-based medical imaging and informatics 581–586
 - research projects 586–587
 - security privacy 586
 - values 577, 579–580
 - variety 577, 580–581
 - velocity 577, 581, 585
 - veracity 577, 580, 583
 - volume 577–579
 - vulnerability and complexity 577
 - Biomedical informatics 29–30
 - Bispectral index system (BIS) 550
 - Blobstore 331
 - Bluetooth™ 116
 - Bluetooth Special Interest Group (SIG) 116
 - B-mode (brightness) ultrasound
 - scanning 51–52
 - Bone age assessment (BAA) of children 464
 - CAD module 472–473
 - CAD–PACS integration 497, 499
 - CAD vs. radiologists' assessment of bone age 484–489
 - clinical evaluation of CAD system
 - clinical environment 489–490
 - workflow design 490–491
 - cross-racial comparisons 475–478
 - data collection
 - case selection criteria 467
 - film digitization 468–469
 - image acquisition 468–469
 - image interpretation 468
 - subject recruitment 467
 - summary 468
 - development of CAD method 466–467
 - digital hand atlas
 - all subjects combined in 486–489
 - boys only, compared with radiologists' assessments 488
 - for clinical evaluation 477–479
 - database of 471–472, 475
 - girls only, compared with radiologists' assessments 487
 - performance of 471–472
 - research supports 470–472
 - fuzzy logic 473
 - hand radiograph 466–467
 - integrating CAD with other informatics systems 493
 - BAA DICOM structured reporting 494–495
 - computational services in data grid 495–498
 - content-based DICOM-SR with CAD 495
 - data grid computational service 497–498
 - integration of CAD with PACS-based multimedia informatics
 - fuzzy integration 482–483
 - fuzzy logic 479
 - fuzzy system architecture 479–482
 - Los Angeles County General Hospital 493
 - radiologists' interpretation 474
 - research supports 470–472
 - statistical analysis 473–475
 - validation of the CAD 483–489
 - web-based BAA clinical evaluation system
 - CAD server 491
 - graphical user interface 491–493
 - Web server 491
 - BrainLab workstation 319
 - Breast MR angiogram 72, 75
- C**
- CAD–PACS integration 425, 452–456
 - advantages 427–428
 - DICOM standard and IHE workflow profiles 428
 - DICOM structured reporting 428, 429
 - IHE profiles 429
 - in laboratory environment 452, 454
 - requirement/need for 427–428
 - security and 421
 - toolkit 429–432
 - CAD–PACS simulator 329
 - bone age assessment of children 333–335
 - CAD algorithm, evaluation of 332–333
 - characteristics 332
 - in clinical environment 333, 335
 - components and functions 332
 - integration 331–332
 - in laboratory environment 333, 334

- CAD system
 - bone age assessment
 - clinical environment 489–490
 - content-based DICOM-SR 495
 - development of 466–467
 - workflow design 490–491
 - development in AIH
 - difficult cases 441, 444
 - extract candidates 439–441
 - knowledge-based classification 441–443
 - localization of AIH candidates 440–441
 - realignment of the image 437–439
 - segmentation of the brain 436–437
 - training and validation 441, 443, 445
- C and C++ programming languages 101, 152
- Cardiac Cath Workflow (CATH) 145
- Carpal bone fuzzy subsystem 481
- CAT-5 cables 116
- Cathode ray tube (CRT) 255–256
- Charge posting (CHG) 148
- Chromosome karyotyping 30–31
- Cine loop ultrasound 53–54
- Classical PACS WS model 100
- Clearinghouse 200–202
- Client-server model 106–107
- Cloud-based PACS archive
 - cloud storage workflow 410, 412
 - data query and retrieve functions 410, 413
 - experiment 408–409
 - PACS cloud architecture 410, 411
- Cloud computing 413
 - and big data 575–576
 - and cloud storage 405
 - NIST definition 406
 - service models 404–405
 - services in archive architecture 331
- Cloud Storage 405
- Color display 258
- Color Doppler ultrasound imaging 53
- Common Object Request Broker Architecture (CORBA@BASIC) 184
- Communication and networks
 - network technologies (*see* Network technologies)
 - OSI and DOD 110, 112–113
- Component-based Web Server
 - architecture of 184–185
 - component software technologies 183–184
 - display workstation 186–188
 - query/retrieve DICOM image/data
 - in PACS archive server 185–186
 - in Web Server 184–185
- Component Object Model (COM) 184
- Comprehensive electronic patient record 319–320
- Compressed image file 85
- Computed Maxillofacial Imaging Congress (CMI) 29
- Computed radiography (CR) 17–18
 - examples of 46–48
- Computer-aided detection/diagnosis (CAD/CADx)
 - average bone age of child 464–466
 - decision support 421
 - in mammography 420
 - research and development 421–423
 - system and evaluation 421
 - target applications 421
 - usefulness and practicality 420
 - with DICOM PACS and MIII 425
 - without PACS
 - with digital image 424
 - without digital image 423–424
 - workflow 429–430
- Computer-assisted radiology and surgery (CARS) 29
- Connectivity and open architecture 102
- Consistent Presentation of Images (CPI) 148
- Consistent time (CT) 146
- Content mapping resource 140
- Continuous conscious electroencephalogram monitoring 528, 531
- Conventional direct Digital 2-D projection radiography 46
- Convention transmission X-ray computed tomography (CT) 58
- CORBA 127
- Core middleware layer, MIDG 356
- CR image information object class 133
- Cross-enterprise document media interchange (XDM) 146
- Cross-enterprise document reliable interchange (XDR) 146
- Cross-enterprise document sharing (XDS) 146, 244

- Cross-enterprise document sharing for imaging (XDS-I) 148
 - integration profile 192, 331, 366
 - description 193–194
 - implementation in second-generation MIDG 369–371
- Cross-enterprise sharing of scanned documents (XDS-SD) 146

d

- Data access interface (DAI) 225
- Data and image acquisition gateways 98–99
- Database GW 98
- Database services 243
- Database-to-database transfer
 - method 172–173
- Data flow
 - DICOM–CAD–IHE™, Third Edition 432, 433
 - DICOM–PACS–IHE™, Second Edition 432, 433
 - DICOM–SC, First Edition 431, 432
- Data grid 222
 - clinical trials 233–234
 - data migration 236–238
 - dedicated breast MRI enterprise (*see* Dedicated breast (DB) MRI enterprise data grid)
 - for enterprise PACS 223–225
 - enterprise PACS daily clinical operation 224–226
 - image-based clinical trials 234
 - image/data security in 247–249
 - image storage and backup 236–237
 - independent clinical service 250
 - IPILab 222–224
 - multiple clinical trials 239
 - role of radiology core in imaging-based clinical trials 234–236
 - sociotechnical considerations 248, 250
- Data Grid simulator (DGS)
 - with cloud computing design 331
 - components and connectivity 329
 - description 329
 - functions of 329
- Data migration 236–238
- Data persistence manager 356
- Data reliability 102–103
- Data security 103
- Decoding 85
- Dedicated breast (DB) MRI and DICOM Grid
 - Access Point (GAP) 242–243
- Dedicated breast (DB) MRI enterprise data grid
 - components 240–243
 - data grid for 239–240
 - functions of 240
 - IHE XDS-I workflow profile 244–24
 - image archive and backup, query/retrieve and disaster recovery 243
- Deidentification/anonymization
 - techniques 586
- Density resolution 41, 43–44
- Department of Radiological Sciences and the Biomedical Physics Graduate Program 10–11
- Desktop workstation 263
- Device Enterprise Communication (DEC) 147
- Diagnostic workstation 260
- Diagnostic WSs 99
- DICOM. *See* Digital Imaging and Communications in Medicine (DICOM)
- DICOM-based computer-aided detection
 - acute intracranial hemorrhage
 - CAD–PACS integration 452–456
 - CAD system development 436–443
 - clinical aspects 435–436
 - clinical evaluation 451
 - evaluation of the CAD 443–451
 - next steps for the development of CAD 451–454
 - multiple sclerosis
 - CAD–PACS toolkit 459–460
 - data collection 457–458
 - detection on MRI 456–457
 - DICOM–SR document 457–459
 - DICOM structured reporting and CAD–PACS-based integration toolkit 456–457
 - MS detection 460–461
- DICOM-based image acquisition gateway
 - determination of the end of an image series 160–162
 - gateway computer components and database management 158–160
- DICOM–CAD–IHE™, Third Edition 432, 433
- DICOM-compliance image acquisition
 - gateway 155–156
- DICOM compliance PACS broker

- concept 166–167
- implementation 166–167
- DICOM-compliant PACS-based archive server
 - advantages 397
 - hardware components 399, 400
 - image acquisition gateways 398, 399
 - image communication 397, 398
 - Q/R service class 397
 - software 400, 401
 - storage service class 397
 - workflow 400, 401
- DICOM conformance PS 3.2–1996 136
- DICOM Conversion Unit (DCU) 242
- “DICOM message service elements” (DIMSEs) 134
- DICOM–PACS–IHE, Second Edition 432, 433
- DICOM PC-based display workstation
 - software 269
 - software architecture 272–273
 - software modules
 - image communication 274
 - image display program 275
 - patient folder management 274–275
 - query and retrieve 275
 - software system 270, 272
- DICOM-RT archive server 307–308
- DICOM-RT-based ePR system architecture
 - design 306–307
- DICOM-RT gateway 306–307
- DICOM-RT object input 306–307
- DICOM-RT objects 304–306
- DICOM-RT web-based ePR server 308–309
- DICOM-SC, First Edition 431, 432
- DICOM 3.0 Standard
 - DICOM communication 135–136
 - DICOM conformance 136
 - DICOM data format 129, 131, 132
 - DICOM file format 132–133
 - DICOM model of the real world 129, 131–132
 - DICOM services 134
 - object class and service class 133–134
 - query and retrieve 138–139
 - send and receive 136–137
- Difference image 87
- Diffusion tensor MRI (DTI) 75–76
- Digital Electronic Computers in Biomedical Science 5
- Digital hand atlas (DHA)
 - all subjects combined in 486–489
 - boys only, compared with radiologists’ assessments 488
 - for clinical evaluation 477–479
 - database of 471–472, 475
 - girls only, compared with radiologists’ assessments 487
 - performance of 471–472
 - research supports 470–472
- Digital image 39–40
- Digital Imaging and Communications in Medicine (DICOM) 124
 - acquisition gateway 156–157
 - communication protocol 101
 - compliance 157–158
 - data format 129, 131, 132
 - file format 132–133
 - model of the real world 129, 131–132
 - organizational structure
 - content mapping resource 140
 - current DICOM strategic document 141
 - mammography computer-aided detection 139
 - structured reporting 140
 - visible light images 139
 - waveform IOD 140
 - services 134
- Digital Imaging and Communications in Medicine Standard PS 3.1 2008 128–129
- Digital medical imaging
 - density resolution, spatial resolution, and signal-to-noise ratio 41, 43–44
 - digital image 39–40
 - digital medical image 40
 - image display 40, 42
 - image size 40–41
 - radiology workflow 44–45
- Digital radiography 20
- Digital scan converter (DSC) image
 - memory 52
- Digital subscriber lines (DSL) 117
- Digital-to-analog (D/A) conversion 40
- Digitized/digital medical images 40
- Digitizing, printing, and CD copying
 - workstation 261–262
- Direct digital input, Fuji CR system 18–19

- Direct sequence spread spectrum (DSSS) modulation 115
- Displayable Reports (DRPT) 145
- Display monitor 255–256
- Display of 4-D medical images and fusion images 82–83
- Display workstations 99–100, 186–188
 - analysis workstation 261–262
 - basic software functions 267–271
 - desktop workstation 263
 - diagnostic workstation 260
 - DICOM PC-based display workstation software 269–270, 272–25
 - digitizing, printing, and CD copying workstation 261–262
 - image display and measurement functions
 - distance, area, and average gray level measurements 265
 - histogram modification 263–264
 - image reverse 264
 - montage 267
 - optimization of image perception in soft display 265–267
 - window and level 263
 - zoom and scroll 263
 - intelligence workstation
 - characteristics of true 2½-D and true 3-D 282–283
 - true 3-D 283–285
 - “true 2½-D” and “true 3-D” image workstations 277–282
 - interactive teaching workstation 262
 - PACS-based (*see* PACS-based display workstations)
 - PACS-based multidimensional image display 276–278
 - post-processing workflow 276
 - review workstation 260–261
 - specialized post-processing workstation 277–280
 - 3-D printing
 - technology 285
 - terminology and methods 285–286
 - use of 286–289
 - workstation user interface 268–271
- Distributed computing
 - concept of 217–218
 - in PACS and medical imaging environment 218–219

- Distributed image file server 179–181
- Dose information object 304–305
- Dose-volume histogram (DVH) 293, 296
- Drum input to digital automatic computer (DRIDAC) 5–7
- Drum scanner 17
- Dynamic multimedia 321

e

- Echocardiography Workflow (ECHO) 145
- EchoPixel True 2½-D image 282
- Echo-planar imaging (EPI) 73
- Electronic healthcare record integration, in regional healthcare
 - imaging sharing implementation 205–206
 - overview 202–203
 - results 207–208
- XDS-I-based regional collaborative imaging sharing solution 203–205
- Electronic medical record (EMR) system 559, 561
- IIA-MISS
 - advantages 569
 - data collection 567–568
 - qualitative results 565, 567
 - statistical analysis 568–569
 - use and training 564–565
- Electronic patient record (ePR) MISS system
 - architecture 538–540
 - integration unit
 - input data and archive 540
 - out of range input data alert message 540–541
 - tandem ePR server 541–542
 - database schema 542–543
 - data storage and archive and system database 542
 - system security 543
 - tandem system 543
 - tandem gateway server
 - intra-op stage 541
 - post-op stage 541
 - pre-op stage 541
 - visualization and display 543
- Electronic patient record (ePR) system
 - data model 303–304
 - evidence-based 505–506
 - goals of 506
 - MISS ePR system 340–342

- proton therapy (*see* Proton therapy ePR system)
 - software organization 300
 - Electronic portal imaging device (EPID) 297
 - Emergency department encounter record (EDER) 147
 - Emergency department referral (EDR) 147
 - Emission computed tomography (ECT) 61, 63, 65–67
 - Encoding 85
 - Endoscopic imaging 54–55
 - Enterprise PACS-based multimedia and ePR system with image distribution 110–111
 - Enterprise PACS daily clinical operation 224–226
 - Enterprise user authentication (EUA) 146
 - Enterprise-wide information systems (IHE) 177–178
 - Ethernet 116–117
 - Ethernet communication system 13–14
 - Evidence documents (ED) 145, 148
 - Exchange of personal health record content (XPHR) 147
 - Explicit value representations (VR) transfer syntax 132
 - Extensible access control markup language (XACML) 203
 - Extensible markup language (XML) 101, 153
 - External beam radiotherapy (RT) 292
 - Eye care displayable report (ECDR) 146
 - Eye care evidence document (ECED) 146
 - Eye care workflow (EYECARE) 146
- f**
- Fabric layer, MIDG 356
 - Fail-safe gateway design 168–169
 - Failsafe tandem gateway system 169
 - Fast Ethernet 114
 - Fault-tolerance tests 366, 380
 - Fault-tolerant data grid 226–227
 - archive and backup 227–228
 - disaster recovery 229–230
 - query/retrieve 228–229
 - Fiber optics 116
 - File transfer protocol (FTP) 110
 - Film-based CAD mammography 424
 - Film input to digital automatic computer (FIDAC) 5–7
 - 512 image 40
 - Four-dimensional, multimodality, and fusion imaging
 - display of 4-D medical images and fusion images 82–83
 - from 3-D to 4-D imaging 78–80
 - image fusion 82
 - image registration 82
 - medical imaging 83–87
 - multimodality 3-D and 4-D imaging 79, 81–82
 - Four-dimensional (4-D) PET-CT imaging 85–88
 - Four-dimensional (4-D) ultrasound imaging 83–84
 - Four-dimensional (4-D) X-ray CT imaging 83, 85
 - 4K digital mammogram 40
 - Fuji computed radiography (FCR) system 17–18
 - Fuji computed radiography (FCR) XG5000 system 46–47
 - Full-field direct digital mammography (FFDDM)
 - screen/film cassette and digital mammography 46–47
 - slot-scanning full-field direct digital mammography 47–48, 50
 - Functional MRI (fMRI) 75
 - Functional status assessments (FSA) 147
 - Fused filament fabrication 285–286
 - Fuzzy logic, BAA 473
 - Fuzzy system architecture, BAA
 - carpal bone fuzzy subsystem 481
 - knowledge base derived from the digital hand atlas 479–480
 - phalangeal fuzzy subsystem 480–481
 - wrist joint fuzzy subsystem 481–482
- g**
- Gamma camera and associated imaging system 51
 - GAP servers 355
 - Gateways (GW) 98
 - clinical operation and reliability of 168–169
 - data and image acquisition 98–99
 - fail-safe gateway design 168–169
 - weakness 168

Generic PACS-based multimedia architecture and workflow 98, 103–104
 Gigabit Ethernet 114
 Global superhighway 116
 Globus Toolkit 221–222
 Globus Toolkit 4.0 221
 Graphical user interface (GUI) design 311–313
 Greenfield, M. 11–12
Greulich and Pyle (G&P) Hand Atlas, 464
 Grid-based IHE XDS-I image sharing solution 586
 Grid computing
 concept of 219
 current technology 220–221
 Globus Toolkit 4.0 221
 integrating DICOM technology with the Globus Toolkit 221–222
 Grid resource allocation and management (GRAM) service 497

h

Hadoop distributed file system 583
 Hand radiograph, BAA 466–467
 Healthcare big data 586
 Health Insurance Portability and Accountability Act (HIPAA) 103, 467
 Health Level 7 (HL7) standard
 example 125–126
 OSI model 124
 trend in 126–127
 user-vendor committee 124
 Hierarchical storage systems 16
 in PACS 391–392
 High-definition multimedia interface (HDMI) 114
 High-performance computing integrated biomedical imaging e-science platform 587
 High-quality Ws 99
 HI-PACS gateway 164–165
 HL7 message development framework (MDF) 127
 HL7 standard. *See* Health Level 7 (HL7) standard
 HL7 Version 3 126–127
 HL7 Version 2.X 126–127
 Hospital Information System (HIS) 8, 98, 169–171
 Hounsfield, Godfrey N. 8

Huang, H.K. 8, 12, 13, 30
 Hypertext transfer protocol (HTTP) 181, 314
 Hypofractionation dose protocol 508, 520

i

IAT simulators 329
 IEEE 802.3 116
 IHE 2020 vision 151
 IHE XDS/XDS-I profiles
 brief description 193–194
 comparison of three pilot studies 209–210
 electronic healthcare record integration in regional healthcare 202–209
 extension of XDS-I profile-based image sharing 211–212
 image sharing for cross-enterprise healthcare with federated integration 194–199, 207
 performance and storage 211
 principles 191
 security issues 210–211
 XDS-I-based patient-controlled image sharing solution 200–202, 207
 IIA-MISS. *See* Integrated image-assisted minimally invasive spinal surgery (IIA-MISS)
 Image acquisition GW 98
 Image-assisted knowledge discovery and decision making 320–321
 Image-assisted minimally invasive spinal surgery (IA-MISS) 560
 algorithm of spine care 531, 534
 bridging the gap between diagnostic images and surgical treatment 526–527
 on cervical, thoracic, and lumbar spines 527–528
 clinical site 536
 continuous conscious electroencephalogram monitoring 528, 531
 endoscopic imaging system and C-Arm DF 528, 530
 ePR MISS system architecture
 major components 539–544
 overall 538–539
 general MISS workflow 535–536
 goals of ePR 534–535
 intra-op module 547, 549
 data acquired during surgery 550
 graphical user interface 552
 interaction with the gateway 552

- internal architecture of the integration unit 551
- participants in the OR 550
- rules-based alert mechanism 552–553
- location of problematic disc marking 528, 532
- MRI 529, 533
- multimedia ePR system 534
 - data model and standards 536–537
 - intra-op workflow 538–539
 - preoperative workflow 537–538
- patient surgical outcome 529, 533
- post-op module
 - follow-up pain surveys 554
 - graphical user interface 553–554
 - participants 553
 - patient in the recovery area 553
 - stage 553
- pre-op authoring module 543
 - graphical user interface 546–549
 - organization of the pre-op data 545
 - participants in the surgical planning 545
 - surgical whiteboard data 545–546
 - workflow analysis 544, 546
- surgical team assembling 528–529
- system deployment
 - hardware installation 555
 - planning and design phase 554–555
 - software installation 556
 - special software for training 556
- tissue modulation technology 528, 532
- training and supports for clinical users 556–557
- Image-assisted surgery (IAS) ePR simulators 342–343
 - data flow 339
 - in laboratory environment 340
 - role 338–339
 - workflow
 - intra-op phase 339–340
 - post-op phase 340
 - pre-op phase 339
- Image-based clinical trials 234
- Image communication 274
- Image compression 16
 - acceptable compression ratio 87–89
 - compressed image file 85
 - compression ratio 87
 - difference image 87
 - encoding and decoding 85
 - reconstructed image from a compressed image file 85
 - wavelet transform method 88, 90–93
- Image data communication 117
- Image display 40, 42
 - board 255–256
 - hardware 254–255
 - and measurement functions
 - distance, area, and average gray level measurements 265
 - histogram modification 263–264
 - image reverse 264
 - montage 267
 - optimization of image perception in soft display 265–267
 - window and level 263
 - zoom and scroll 263
 - program 275
- Image-enabled EHR (iEHR) 194
- Image fusion 82, 148
- Image information object 304–305
- Image pre-processing and display 167–168
- Image processing algorithm 472–473
- Image Processing and Informatics Laboratory (IPILab) 118, 222–224
- Image Processing Laboratory (IPL) at UCLA 13–14
- Image querying and retrieval 195–196
- Image registering 196
- Image registration 82
- Image sharing for cross-enterprise healthcare with federated integration
 - background 194
 - image sharing architecture, components and workflows 195–196
 - image sharing models 197–198
 - key issues identified in pilot testing 196
 - performance 198–199
 - results 207
- Image sharing models 197–198
- Image size 40–41
- Image workstation
 - analysis workstation 261–262
 - desktop workstation 263
 - diagnostic workstation 260
 - digitizing, printing, and CD copying workstation 261–262
 - interactive teaching workstation 262
 - review workstation 260–261

- Imaging camera for medical applications 17
 - Imaging component
 - in treatment delivery 293–295, 297
 - in treatment planning 292–297
 - Imaging service workflow efficiency and quality 581
 - Implantable Device Cardiac Observation (IDCO) 145
 - Import Reconciliation Workflow (IRWF) 148
 - InCor 118, 120
 - Industry standards 101–102
 - Information object definitions (IODs) 309
 - Information sharing 319
 - Infrastructure as a service (IaaS) 405
 - Integrated image-assisted minimally invasive spinal surgery (IIA-MISS)
 - clinical EMR system 559, 561
 - advantages 569
 - data collection 567–568
 - qualitative results 565, 567
 - statistical analysis 568–569
 - use and training 564–565
 - intra-op display monitor 565–567
 - planning stage 561–564
 - post-op pages 565, 568
 - pre-op display 565
 - Integrating the Healthcare Enterprise (IHE) 102
 - data model, actors and integration profiles 144
 - examples 149–151
 - high-level information model 142
 - history 142
 - IHE activities 144
 - IHE Integration Workshop in 2006 142–143
 - IHE 2020 Vision 151
 - international expansion 149, 151
 - multidisciplinary effort 149
 - profiles 144–148
 - Intelligent treatment plan navigator (ITPN) 509
 - Interactive display with multiple monitors 20–21
 - Interactive teaching workstation 262
 - Interface engine 172–174
 - International Society for Optical Engineering (SPIE) 27–28
 - International Standards Organization (ISO) 110
 - Internet 116–117, 181
 - Internet2 (I2)
 - connection of three international sites 118–120
 - image data communication 117
 - major international interconnection points 118
 - observations 120
 - Intra-op module, MISS 547, 549
 - data acquired during surgery 550
 - graphical user interface 552
 - interaction with the gateway 552
 - internal architecture of the integration unit 551
 - participants in the OR 550
 - rules-based alert mechanism 552–553
 - Intravascular ultrasound (IVUS)
 - technology 68
- j**
- Japan medical imaging technology 26–27
 - JavaBeans 184
 - Java (just another vague acronym)
 - programming language platform 101
 - Journal of Applied Clinical Medical Physics (JACMP)*, 12
- k**
- Kangarloo, H. 12
 - Key image note (KIN) profile 148, 429
 - Knowledge base (KB) data-mining search engine 509
 - Konica digital radiography system 20
 - Konica laser film scanner 17–18
- l**
- Laboratory Scheduled Workflow (LSWF) 147
 - Large-capacity optical disk Jukebox 16
 - Laser film printer for X-ray images 16–17
 - Laser film scanner 17–18
 - Ledley, Robert S. 4–8
 - Light imaging 54–55, 76–77
 - Linear accelerator (LINAC) 297
 - Liquid crystal (LCD) 255–256
 - Liu, Brent 403
 - Local area network (LAN) 100

- LOINC Test Codes Subset (LTCS) 147
- Los Angeles County General Hospital 493
- Lossless digital signature embedding (LDSE)
 - procedure 247
- Lung CT images, segmentation and
 - classification of 587
- m**
- Magnetic resonance angiography (MRA)
 - imaging 261–262
- Magnetic resonance imaging (MRI)
 - basics 68–69
 - image production 69–70
 - MR angiography 72, 75
 - pulse-sequence images 72–73, 75–76
 - steps in producing 70–72
 - 3-D dedicated breast MR angiogram 71, 74
 - 3-D fetal 3 T MR images 71, 74
 - T1 weighted images 71, 73
- Mammography computer-aided detection (CAdE) 139
- Mammography Image (MAMMO) 148
- Media access control (MAC) 116
- Medical image big data. *See* Big data
- Medical imaging. *See also* Three-dimensional (3-D) medical imaging; Two-dimensional (2-D) medical imaging
 - automatic computerized transverse axial 8–9
 - and informatics data 576
 - Ledley's contributions 4–7, 8
 - pattern recognition laboratory 4–7
- Medical imaging informatics infrastructure (MIII) resource 423
- Medical imaging informatics infrastructure (MIII) platform 326, 327
- Medical imaging informatics (MII)
 - simulator
 - defined 326
 - organization 326, 327
- Medical summaries (MS) 147
- Message header segment (MSH) 125–126
- Micro-densitometer 17
- Minimally invasive spinal surgery (MISS). *See* Image-assisted minimally invasive spinal surgery (IA-MISS)
- Minimally invasive surgery 298–299
- MISS ePR system 340–342
- Modality integration unit (MIU) 98
- Modulation transfer function (MTF) 257
- Molecular imaging data grid (MIDG) 347
 - connectivity and workflow 356–358
 - current status and next-generation 360
 - experimental setup 358
 - implementation scenario 351
 - in healthcare informatics 360
 - objective 350
 - performance evaluation 359–360
 - sample preclinical molecular imaging datasets 358–359
 - simulator 329–331
 - software architecture 352
 - application layer 353–355
 - core middleware layer 356
 - fabric layer 356
 - user-level middleware layer 353, 355–356
- MR angiography (MRA) 72, 75
- MRI. *See* Magnetic resonance imaging (MRI)
- MTOM/XOP 210
- Multi-center MIDG implementation
 - data collection 375–377
 - data normalization 375–376
 - DICOM tags 375, 377
 - download performance 378, 380
 - evaluation steps 372, 374
 - fault tolerance 380
 - hardware requirements 374
 - network bandwidths 374, 375
 - purpose 371
 - software requirements 374
 - three site test-bed 372, 373
 - upload performance 378, 379
- USC Image Processing and Informatics Lab 372
- USC Molecular Imaging Center 372
- USC Ultrasound Transducer Resource Center 372
- Multimedia ePR system, in radiotherapy (RT)
 - communication between isolated information systems and archival of information 319
 - comprehensive ePR model 319–320
 - database schema 309, 311
 - of RT archive server 311–312
 - data collection for the prototype system 314–315

- Multimedia ePR system, in radiotherapy (RT) (*cont'd*)
 - DICOM-RT archive server 307–308
 - DICOM-RT-based ePR system architecture design 306–307
 - DICOM-RT gateway 306–307
 - DICOM-RT object input 306–307
 - DICOM-RT objects 304–306
 - DICOM-RT web-based ePR server 308–309
 - ePR data model 303–304
 - graphical user interface design 311–313
 - GUI in the WS 314
 - hardware and software 314
 - image-assisted knowledge discovery and decision making 320–321
 - information sharing 319
 - multimedia ePR system 315–318
 - background 299–300
 - database schema 300–301
 - data flow model 300
 - data model 300, 302
 - ePR software organization 300
 - minimally invasive surgery 298–299
 - multimodality 2-D and 3-D imaging
 - fusion of 3-D MRI and 3-D CT images 296, 298
 - image registration 293–295, 297–298
 - imaging component in treatment delivery 293–295, 297
 - imaging component in treatment planning 292–297
 - radiotherapy workflow 292
 - radiotherapy planning and treatment 301–303
 - RT ePR prototype 312, 314
 - RT web client workstation 309–310
 - workflow 302–303
 - Multimedia ePR system, MISS 534
 - data model and standards 536–537
 - intra-op workflow 538–539
 - preoperative workflow 537–538
 - Multimodality 2-D and 3-D imaging
 - fusion of 3-D MRI and 3-D CT images 296, 298
 - image registration 293–295, 297–298
 - imaging component in treatment delivery 293–295, 297
 - imaging component in treatment planning 292–297
 - radiotherapy workflow 292
 - radiotherapy planning and treatment 301–303
 - RT ePR prototype 312, 314
 - RT web client workstation 309–310
 - workflow 302–303
 - Multimodality 3-D and 4-D imaging 79, 81–82
 - Multimodality Registration for Radiation Oncology (MMR-RO) 147
 - Multiple display controller 15
 - Multiple-reader multiple-case receiver operating characteristic analysis 445–447
 - Multiple sclerosis (MS)
 - CAD-PACS toolkit 459–460
 - data collection 457–458
 - detection on MRI 456–457
 - DICOM-SR document 457–459
 - DICOM structured reporting and CAD-PACS-based integration toolkit 456–457
 - MS detection 460–461
 - Multipurpose internet mail extension (MIME) message 184
- n**
- National Electrical Manufacturers Association (NEMA) 127
 - NATO Advanced Science Institute (ASI) 23–25
 - Netherlands National Foundation 23
 - Network technologies
 - asynchronous transfer mode technology 114, 115
 - Ethernet 116–117
 - fast Ethernet and gigabit Ethernet 114
 - Internet 116–117
 - Internet2 117–120
 - standard Ethernet 113–114
 - wireless networks 115–116
 - Neuroimaging 435–436
 - Neurosurgery 570, 571
 - Next-generation Internet (NGI) 118
 - Non-DICOM files 314–315
 - Normalized information object classes 133
 - Normal treatment planning-simple (NTPL-S) 147
 - Nuclear medicine image (NM) 148
 - Nuclear medicine (NM) imaging 48–51
 - gamma camera and associated imaging system 51
 - principles of 48–49, 51

o

- Object class 133–134
- Open grid services architecture (OGSA) 220, 331
- Open Group 406–408
- Open systems interconnection (OSI) 110, 112–113
- Optical carrier level 1 (OC-1) 115
- Organizational root 133
- Orthogonal frequency division multiplexing (OFDM) 115
- Oswestry disability index 545–546

p

- PACS-based architectures
 - client-server model and data flow 106–107
 - enterprise PACS-based multimedia and ePR system with image distribution 110–111
 - stand-alone PACS-based model and data flow 105–106
 - teleradiology model 108–110
 - web-based model 107–108
- PACS-based archive server
 - DICOM 397–400
 - system operations 396–397
- PACS-based display workstations
 - color display 258
 - display monitor 255–256
 - image display board 255–256
 - image display hardware 254–255
 - resolution 256–259
- PACS-based multidimensional image display 276–278
- PACS-based multimedia biomedical imaging informatics 390
- PACS components and network
 - application servers 98, 100
 - components 97
 - data and image acquisition gateways 98–99
 - display workstations 99–100
 - PACS server and archive 99
 - system networks 100–101
- PACS–ePR simulator
 - components and data flow 328
 - description 328
 - function and data flow 328
 - imaging informatics applications 329
- PACS image management design
 - concept 391–395
- PACS infrastructure design concept
 - connectivity and open architecture 102
 - data reliability 102–103
 - industry standards 101–102
 - security 103
- PACS modality gateway
 - and HI-PACS 164–165
 - ultrasound modality 165–166
- PACS server and archive 99
 - functions of 395–396
 - positions of 391
 - RIS and HIS interface 396
 - system configuration 392
 - archive server 393–394
 - archive storage 394
 - backup archive system 394
 - communication networks 394–395
 - database system 394
- PACS with HIS and RIS
 - common data 174–175
 - database-to-database transfer
 - method 172–173
 - IHE patient information reconciliation
 - profile 177–178
 - implementation of RIS-PACS
 - interface 174–177
 - interface engine 172–174
 - rationale of interfacing 173
- Parallel virtual machine (PVM) 218
- Patient demographics query (PDQ) 146
- Patient folder management 274–275
- Patient identifier cross-reference and patient demographics query for
 - HL7v3 146
- Patient identifier cross referencing (PIX) 146
- Patient information object class 133
- Patient information reconciliation (PIR) 148
- Patient record architecture (PRA) 127
- Patient synchronized application (PSA) 146
- Pattern recognition laboratory (PRL) 4–7, 10
- Personal image filing system 16
- Personnel white pages (PWP) 146
- Phalangeal fuzzy subsystem 480–481
- Picture archiving and communication system (PACS)
 - ATM communication technology 17
 - biomedical informatics 29–30

- Picture archiving and communication system (PACS) (*cont'd*)
 - CARS 29
 - chromosome karyotyping 30–31
 - collaboration of the UCLA Team with the US Medical Imaging Industry 25
 - computed radiography 17–18
 - Department of Radiological Sciences and the Biomedical Physics Graduate Program 10–11
 - digital radiography 20
 - diligent contributors 34
 - direct digital input, Fuji CR 18–19
 - end users 33–34
 - EuroPACS 28–29
 - golden era of medical imaging technology
 - research support 32–33
 - Greenfield's contributions 11–12
 - hierarchical storage system 16
 - HIS/RIS/PACS system 8, 10
 - Image Compression project 16
 - image processing laboratory at UCLA 13–14
 - interactive display with multiple monitors 20–21
 - Japan medical imaging technology 26–27
 - Kangaroo's contributions 12
 - laser film printer for X-ray images 16–17
 - laser film scanner 17–18
 - medical imaging informatics system
 - 30, 32
 - multiple display controller 15
 - NATO Advanced Science Institute and the UCLA PACS 23–25
 - Netherlands National Foundation and the UCLA PACS 23
 - patents and copyrights 29
 - personal image filing system 16
 - SPIE 27–28
 - US Government Agencies 22–23
 - VAX 11/750 computer system 15
- Picture element 39
- Pixel 39
- Plan information object 304–305
- Platform as a service (PaaS) 405
- PolyU 118, 120
- Portable data for imaging (PDI) 148
- Positron emission tomography (PET) 65–67
- Post-op module, MISS
 - follow-up pain surveys 554
 - graphical user interface 553–554
 - participants 553
 - patient in the recovery area 553
 - stage 553
- Post-processing workflow 148, 276, 429
- Preclinical molecular imaging
 - data model 351–352
 - informatics 348–350, 361
 - modalities 348, 349
- Pre-op authoring module, MISS 543
 - graphical user interface 546–549
 - organization of the pre-op data 545
 - participants in the surgical planning 545
 - surgical whiteboard data 545–546
 - workflow analysis 544, 546
- “Presence of the next series” method 162
- Presentation of Grouped Procedures (PGP) 148
- Protocol 135
- Proton therapy (PT)
 - challenges of 504–505
 - clinical outcomes 508
 - clinical workflow 506–507
 - dose uncertainty and treatment
 - schedule 504–505
 - high cost of 505
 - and prostate cancer 503–504
 - radiation toxicity 508
 - treatment protocols 507–508
- Proton therapy ePR system 520
 - database 512
 - dataflow model 510–511
 - data gateway 508–509
 - decision support tools 509, 520
 - ePR server 509
 - laboratory implementation 512
 - for prostate cancer patients 506, 521
 - data collection 512, 513
 - follow-up data form 513, 514
 - knowledge-based search engine query input 515, 516
 - patient information and treatment plan 515
 - pretreatment clinical parameters 513
 - treatment plan modification 517–519
 - system architecture 508–509

- visualization and display tools 509
- WampServer version 2.0 511
- web technology 511
- Pure teleradiology model 108–109

q

- Quantitative imaging 583–584
- “Query and retrieve” images 136, 138
- Query for existing data (QED) 147
- Query/retrieve DICOM image/data
 - in PACS archive server 185–186
 - in Web Server 184–185
- Queue software 101

r

- Radiation therapy 504, 507, 520. *See also*
 - Proton therapy (PT)
- Radiation toxicity 508
- Radiology information system (RIS) 8, 98, 171–172
- Radiology workflow 44–45
- Radiotherapy (RT) ePR simulator
 - architecture and data flow 335–337
 - components and features 335, 336
 - description 335
 - intelligent treatment plan navigator 337, 338
 - role 337
 - step-by-step simulation, of knowledge discovery 337
- Radiotherapy planning and treatment 301–303
- RAD-69/WADO hybrid image retrieval 193
- Real-time, interactive virtual reality system 282
- Reasoning Foundations of Medical Diagnosis 5
- Reconstructed image 85
- Redundant array of independent disks (RAID) 236
- Reference information model (RIM) 127
- Registry stored query transaction for cross-enterprise document sharing profile 146
- Reporting workflow (RWF) 148
- Request information for display (RID) 146
- Research and development (R&D), CAD 421–423
- Research projects, medical imaging big data

- grid-based IHE XDS-I image sharing solution 586
- high-performance computing integrated biomedical imaging e-science platform 587
- lung CT images, segmentation and classification of 587
- semantic searching engine, for RIS/PACS 586
- 3-D enabled visual indexing 587
- Resolution 256–259
- Retrieve form for data capture (RFD) 146
- Retrieve Imaging Document set 69 (RAD-69) 192

- Review workstation 99, 260–261
- Rotating gamma camera system 63, 65
- RT archive server 311–312
- RT ePR prototype 312, 314
- RT web client workstation 309–310

s

- Sampling modes and image display 52–53
- Scheduled workflow (SWF) 148
- Screen/film cassette and digital mammography 46–47
- Second-generation MIDG
 - benefits 383
 - centralized queue handling 369
 - data transmission performance 380–381
 - design architecture 366
 - DICOM-compliant file management web-services 367
 - distributed connectivity 368
 - future research and development 384–386
 - GUI Web server 381–382
 - IHE XDS-i integration profile implementation 369–371
 - implementation at molecular imaging facility 381–383
 - improved research workflow 383
 - intelligent routing service 371
 - multi-center implementation 371–375
 - with OGSA data grid infrastructure 369, 370
 - performance 369
 - preclinical imaging workflow 367–368
 - rules-based backup 371
 - service-oriented design 369
 - system overview 368–369

- Secure socket layer (SSL) 201
 - Security privacy, in big data 586
 - Semantic searching engine (SSE), for RIS/
PACS 586
 - “Send and receive” images 136–137
 - Service 135
 - Service class 133–134
 - Service class provider (SCP) 136
 - Service class user (SCU) 136
 - Service-object pairs (SOPs) 129
 - Shanghai Shen-Kang Hospital Management
Center (SSKPMC) 194
 - Sharing Laboratory Reports
(XD*-LAB) 147
 - Signal-to-noise ratio 41, 43–44
 - Silva, L.B. 408
 - Simple Image and Numeric Report (SINR)
148, 429
 - Single photo emission CT (SPECT) 63, 65
 - Slot-scanning full-field direct digital
mammography 47–48, 50
 - Soft-copy display 40
 - Software as a service (SaaS) 405
 - Software visualization toolkit (VTK) 277
 - Spatial resolution 41, 43–44
 - Specialized post-processing
workstation 277–280
 - Specimen input to digital automatic
computer (SPIDAC) 5–7
 - Spine care, algorithm of 531, 534
 - Spin echo free-induction-decay (FID)
signals 71
 - Spin-echo pulsing sequence 71
 - Spiral imaging readout techniques 73
 - SRT structure set information
object 304–305
 - Stand-alone PACS-based model and data
flow 105–106
 - Stand-alone primary diagnostic
WS 99
 - Standard Ethernet 113–114
 - Static multimedia 321
 - Stereolithography 285–286
 - Stored Query 146
 - Stress testing workflow (STRESS) 145
 - Structured English Query Language
(SEQUEL) 152
 - Structured Query Language (SQL) 101,
152–153
 - Structured reporting (SR) 428, 429
 - BAA DICOM 494–495
 - DICOM organizational structure 140
 - Study information object class 133
 - System networks 100–101
- t**
- TCP/IP communication protocols 102
 - Teaching File and Clinical Trial Export
(TCE) 148
 - Teleradiology model
 - PACS 109–110
 - pure 108–109
 - Thick-client model. *See* Stand-alone PACS-
based model and data flow
 - Thick-client PACS WS 100
 - Thin-client model. *See* Client-server model
 - Thin-client PACS WS 100
 - Three-cores data grid architecture 236–237
 - 3-D CT scanner 59–60
 - 3-D enabled visual indexing, for medical images
and reports 587
 - 3-D fluorescence confocal microscopy 76–77
 - Three-dimensional (3-D) medical imaging
 - emission computed tomography 61, 63,
65–67
 - magnetic resonance imaging (*see* magnetic
resonance imaging (MRI))
 - 3-D fluorescence confocal
microscopy 76–77
 - three-dimensional ultrasound
imaging 68–69
 - 3-D micro imaging and small animal
imaging 76, 79
 - transmission X-ray computed tomography
(*see* transmission X-ray computed
tomography)
 - two-dimensional transmission X-ray
computed tomography 55–58
 - Three-dimensional (3-D) ultrasound
imaging 68–69
 - 3-D lossless digital signature embedding
procedure 247
 - 3-D micro imaging and small animal
imaging 76, 79
 - 3-D printing
 - technology 285
 - terminology and methods 285–286
 - use of 286–289

3-D wavelet transform 90–93
 Tissue modulation technology 528, 532
 Translational medicine 569–571
 Transmission control protocol/internet
 protocol (TCP/IP) 101, 181
 Transmission X-ray computed tomography
 components and data flow of a 3-D CT
 scanner 59–60
 convention 58
 CT image data 60–63
 whole body CT scan 59
 Treatment workflow (TRWF) 147
 “True 2½-D” and “true 3-D” image
 workstations 277–282
 Two-dimensional (2-D) endoscopic
 imaging 54–55
 Two-dimensional (2-D) light imaging 54
 Two-dimensional (2-D) medical imaging
 computed radiography systems 46–48
 conventional direct Digital 2-D projection
 radiography 46
 full-field direct digital
 mammography 46–50
 light and endoscopic imaging 54–55
 nuclear medicine imaging 48–51
 ultrasound imaging (*see* two-dimensional
 (2-D) ultrasound imaging (US))
 Two-dimensional (2-D) transmission X-ray
 computed tomography 55–58
 Two-dimensional (2-D) ultrasound
 imaging (US)
 B-mode (brightness) ultrasound
 scanning 51–52
 cine loop ultrasound 53–54
 color Doppler ultrasound imaging 53
 sampling modes and image display
 52–53
 2-D wavelet transform 90

U

Ultrasound (US) PACS module 165–166
 Ultrasound Transducer Resource Center
 (UTRC) 372
 University Corporation for Advanced Internet
 Development (UCAID) 118
 UNIX operating system 101, 152
 USC Image Processing and Informatics Lab
 (IPI Lab) 372
 USC Molecular Imaging Center 372
 User-level middleware layer, MIDG 353
 collision management 355–356
 data persistence manager 356
 GAP servers 355
 US Government Agencies 22–23

V

Variety, of medical image big data 577, 580–581
 VAX 11/750 computer system 15
 Velocity, of medical image big data 577, 581, 585
 Vendor neutral archive (VNA) 583, 584
 Veracity, in medical image big data 577, 580,
 583
 Very high-speed backbone network
 service(vBNS) 118
 Virtual private network (VPN) 195
 Visible light (VL) images 139
 Visual analog scale (VAS) 545
 Voxel 40

W

Waveform IOD 140
 Web Access to DICOM Persistent Objects
 (WADO) 129
 hybrid image retrieval 192
 Web-based BAA clinical evaluation system
 CAD server 491
 graphical user interface 491–493
 Web server 491
 Web-based data management and image
 distribution
 component-based Web Server 183–188
 distributed image file server 179–181
 PACS-based data management 179–180
 performance evaluation 188–189
 Web Server 181–183
 Web-based ePR system, for breast cancer
 screening 386
 Web-based multi-modality multi-resource
 information integration (MIMI)
 system 361, 384
 Web-based PACS model 107–108
 Web Server
 concept of 182–183
 Web technology 181–182
 Web 100 tuning protocol 118, 120
 Whole body CT scan 59
 Wi-Fi (IEEE 802.11) 116
 Windows NT and XP operating systems 152

- WINDOWS NT/XP operating system 101
- Wireless Ethernet Compatibility Alliance (WECA) 116
- Wireless fidelity (Wi-Fi) 115
- Wireless LAN (WLAN) 115
- Wireless networks 115–116
- Workstation graphic user interface (GUI)
 - basic software functions 267–271
 - workstation user interface 268–271
- Wrist joint fuzzy subsystem 481–482

X

- XDS-I-based patient-controlled image sharing solution
 - background 200
 - key features 202
 - patient-controlled workflow 201
 - results 207
- RSNA image sharing network solution 200–201
- X WINDOW platform 101

