

# INDEX

Note: Page numbers of article titles are in **boldface** type.

- Analog-to-digital converters, 156  
 digitizers as, 170-173  
 for teaching tool production, 231, 233-234
- Asynchronous Transfer Mode, 213-214, 257
- AUTOcyte Pap smear screening system, 268-269, 279
- Automation, of Pap smear screening. See *Pap smear screening, computerized.*
- AutoPap System, 268-271, 279-280
- Back-up systems, for workstation computer, 208-210
- Barcode readers, 212
- Birefringence, in polarization microscopy, 302-303
- Bus, expansion, for workstation, 207
- Cameras, charge-coupled devices as. See *Charge-coupled devices.*
- digital, 234-235  
 for teaching tool production, 231-235  
 for telepathology, 238  
 lighting optimization for, 196-198  
 pixel array, 234  
 video, 211  
 in teaching tool production, 231-234  
 in telepathology, 238  
 lighting optimization for, 196-198
- Cancer, cervical, automated screening for. See *Pap smear screening, computerized.*
- Cathode ray tube, for image display, 181-185
- CCDs. See *Charge-coupled devices.*
- CD-ROM drives, for workstation, 210
- Cell signaling, fluorescent probes for, 309-310
- Cervical cancer screening, automated. See *Pap smear screening, computerized.*
- Charge-coupled devices, as matrix imagers, 154  
 black and white, 157  
 color filters for, 157, 162-163  
 dark current in, 167  
 grades of, 168  
 in fluorescent in situ hybridization, 308  
 in low-light imaging, 165  
 in teaching tool production, 232-233  
 integrating, 166-167  
 intensified, 165-166  
 lighting optimization for, 196-198  
 monochromatic, with pulsed light source, 164  
 noise in, 167-168  
 physics of, 155-156, 158-161  
 silicon intensified target before, 165-166  
 three combined, 163-164  
 topologies of, 157  
 versus line scan devices, 168-170
- Chromosome painting, in fluorescent in situ hybridization, 308
- Client software, for workstation computer, 215-216
- C-mount, for microscopes, 195-196
- Coding, of patient data, for transfer, 224
- Color imaging, 152-154  
 available colors in, 178-179  
 displays for, 181-185  
 film recording technologies in, 188  
 filter systems for, 157, 162-163  
 in teaching tool preparation, 232-233  
 psychometrics of, 176-181
- Color-inkjet printers, for image presentation, 187
- Communication, in imaging technology. See also *Telepathology.*  
 from workstation to other locations, 213-215  
 standards for, 315-322  
 via Internet, 219-220, 241, 256-258  
 via World Wide Web, 223-224
- Compression, image, for telepathology, 254-256

- Computed tomography, as telepathology prototype, 245-246
- Computers. See also *Digital imaging*.  
 in Pap smear screening. See *Pap smear screening, computerized*.  
 in pathologist workstation. See *Workstations*.
- Conferences, visual aids for. See *Teaching tools, digital imaging as*.
- Confidentiality, in patient data transfer, 224, 256-258
- Confocal microscopy, optical sectioning and, 310-312
- Continuous shading technologies, for image presentation, 187
- Contrast enhancement factor, in image manipulation, 289
- Coupling systems, between optical equipment and imager, 195-196
- Cytoanalyzer, 265
- Cytochemistry, fluorescent analogue, 309
- Cytogenetics, fluorescent in situ hybridization in, 308-310
- Cytoskeleton, fluorescent in situ hybridization studies of, 308-309
- Cytotechnology, computerized, in Pap smear screening. See *Pap smear screening, computerized*.
- Dark current, in charge-coupled devices, 167
- Darkfield microscopy, 301
- Data handling, of images. See *Imaging, input technology in; Imaging, output technology in*.  
 in telepathology. See *Telepathology, workstation for*. See *Workstations*.
- Deconvolution, image, in confocal microscopy, 311-312
- Detection devices, in imaging. See *Charge-coupled devices; Imaging, input technology in*.
- Dextrans, fluorescent, in endocytic compartment microscopy, 306
- Dicarbocyanine dye, in fluorescence microscopy, 307
- DICOM standards, current status of, 317-319  
 for image files, 237-240  
 historical review of, 316-317  
 international normalization of, 321  
 organizational structure relating to, 320  
 pathology applications of, 319  
 versus other standards, 320  
 Visible Light Supplement to, 319-320
- Differential interference contrast microscopy, 303-305
- Digital imaging, as teaching tool, 229-249  
 for Pap smear screening, 263-284  
 input technology in. See *Imaging, input technology in*.  
 microscopy applications of, 285-297  
 optical considerations in, 189-200  
 output technology in. See *Imaging, output technology in*.  
 standards for, 315-322  
 telepathology in, 256-261  
 workstation electronic equipment for, 201-228
- Digital Imaging and Communications in Medicine standards. See *DICOM standards*.
- Digital phosphor imager, 170
- Digitizers, in input imaging, 170-173
- Disks and disk drives, for workstation computer, 208-210
- Display systems, color, 181-185  
 continuous shading technologies in, 187  
 for teaching, 240-241  
 for workstation, 206  
 grayscale, 176-177, 181  
 half-tone technologies in, 186-187  
 hard copy, 186  
 monochromatic, 181  
 presentation technologies with, 185-186  
 psychometrics of, 176-181  
 resolution of, 184-185, 240  
 types of, 180
- Dithering, for image storage, 239
- DNA probes, in fluorescent in situ hybridization, 308-310
- Documentation, of images. See *Imaging, output technology in*.
- Dots per inch, in line scanners, 169  
 in slide scanners, 170
- DVD drives, for workstation, 210
- Dye sublimation printer, for image presentation, 187
- Electronic mail (e-mail), 220-221
- Encryption tools, for patient data transfer, 224, 258
- Endocytosis, fluorescence microscopy of, 306-307
- Endoplasmic reticulum, fluorescence microscopy of, 307
- ENG-mount, for microscopes, 195-196
- Expansion bus, for workstation, 207
- Eyepieces, for optical equipment, 191-192
- Files, image, 237-240
- Film, as teaching tool, versus digital images, 229-230  
 for image presentation, 186, 212-213

- for image recording, 188
- Filter systems, color, 157, 162-163
- FISH (fluorescent in situ hybridization), 308-310
- Flat bed scanner, 168-169
- Fluorescence microscopy, 198-200, 305-310
- Fluorescent analogue cytochemistry, 309
- Fluorescent in situ hybridization (FISH), 308-310
- Focal plane systems, for imaging, 190-192
  
- GIF compression, for image storage, 238
- Golgi apparatus, fluorescence microscopy of, 307
- Gray values, in digital imaging for microscopy, 287-289
- Grayscale displays, for image output, 176-177, 181
- Groupware, for workstation, 221-222
  
- Halftone technologies, for image presentation, 186-187
- Hard copy technologies, for image presentation, 186, 212
- Hardware, for pathologist workstation. See *Workstations*.
- Health Level Seven standards, convergence with DICOM, 320
- Histograms, versus image, 289-291
  
- Image capture board, in analog-to-digital conversion, 233-234
- Image deconvolution, in confocal microscopy, 311-312
- Imaging, analysis in, 218
  - as teaching tool, 229-244
  - color. See *Color imaging*.
  - compression in, for telepathology, 254-256
  - dynamic versus static, in telepathology, 247-248
  - editing in, 218
  - file storage and management in, 237-240
  - in Pap smear screening, 263-284
  - in telepathology, 245-261
  - input technology in, 151-174, 212
    - charge-coupled devices. See *Charge-coupled devices*.
    - digitizers, 170-171
    - dynamic range issues in, 171, 173
    - in teaching tool production, 231-233
    - lighting optimization in, 196-198
    - line scan devices, 168-170
    - matrix imagers, 154
    - review of, 151-154
    - slide scanners, 170
  - low-light, 165
  - matrix, 154
  - microscopy applications of, 285-297
  - optical considerations in, 189-200
  - output technology in, 175-188, 212-213
    - color displays, 181-185
    - continuous shading, 187
    - dynamic range issues in, 176-181
    - film recording, 188
    - halftone, 186-187
    - hard copy, 186
    - hardware for, 180
    - monochromatic displays, 181
    - presentation systems, 185-186
    - psychometrics of, 176-181
    - teaching tools, 233, 240-242
  - specialized techniques for, 299-314
  - standards for, 315-322
    - static versus dynamic, in telepathology, 247-248
    - versus histograms, 289-291
    - workstation electronic equipment for, 201-228
- Immunochemistry, fluorescent in situ hybridization in, 309
- In situ hybridization, fluorescent, 308-310
  - in brightfield microscopy, 300
- Infinity optics, for imaging, 192, 195
- Inline color filters, for charge-coupled devices, 157, 162-163
- Input technology, in imaging. See *Imaging, input technology in*.
- Integrating charge-coupled devices, 166-167
- Intensified charge-coupled devices, 165-166
- Intensity transformation function, in image manipulation, 289, 293-297
- Interface formats, between optical equipment and imager, 195-196
- Interference reflection microscopy, 301-302
- Internet, 219-220
  - in image display, for teaching, 241
  - in telepathology, confidentiality issues in, 256-258
- Interoperability, of digital imaging equipment, 315-322
  
- Joint Photographic Experts Group (JPEG) compression, for image storage, 238
  
- Kohler illumination, in microscopy, 198
  
- Licensure, telepathology and, 259

- Lighting optimization, in imaging, 196-198
- Line scan devices, 168-170
- Liquid crystal displays, for image display, 181, 185-186, 213, 241
- Look-up table, in image manipulation, 297
- Lossy image compression, 254-256
- Lotus Notes, 221
- Mach banding, in color vision, 176-177
- Matrix imagers, 154
- Meetings, visual aids for. See *Teaching tools, digital imaging as.*
- Microphone, for workstation computer, 211
- Microscopy, 299-314
  - brightfield, 299-301
  - cameras used with, 232-233
  - confocal, optical sectioning and, 310-312
  - darkfield, 301
  - differential interference contrast, 303-305
  - digital image processing for, 285-297
    - manipulation of, 289, 292-297
    - resolution in, 287, 289
  - fluorescence, 198-200, 305-310
  - fluorescent in situ hybridization (FISH) in, 308-310
  - imaging interface formats for, 195-196
  - imaging planes in, 190-194
  - infinity optics system for, 192, 195
  - interference reflection, 301-302
  - optical interfaces in, 189-190
  - phase-contrast, 299-301
  - photographic optimization for, 198
  - polarization, 302-303
  - robotics, in telepathology, 249-252
  - transmission light, 198, 299-301
- Mitochondrial function, fluorescence microscopy of, 307
- Modems, for workstation, 213-214
- Monitors, computer, for workstation, 206
- Monochromatic displays, 181
- National Electrical Manufacturers Association, in digital image standard development, 316-320
- Noise, in charge-coupled devices, 167-168
- Nuclear staining, in fluorescence microscopy, 307-308
- Operating systems, for workstation computer, 215-216
- Optical considerations, in imaging, 189-200
  - fluorescent light microscopy, 198-200
  - infinity optics system, 192, 195
  - interface formats, 195-196
  - lighting optimization, 196-198
  - microscopic interfaces, 189-190
  - optical character recognition software, 211-212
  - photomicrographic optimization, 198
  - planes, 190-194
  - transmission light microscopy, 198
- Optical sectioning, confocal microscopy and, 310-312
- Output technology, in imaging. See *Imaging, output technology in.*
- Pap smear screening, computerized, 263-284
  - AUTOcyte, 268-269, 279
  - AutoPap System, 268-271, 275-278
  - cost-benefit studies of, 279-280
  - future developments in, 281-283
  - historical review of, 264-267
  - PAPNET, 268, 271-281
  - professional reactions to, 280-281
  - public perceptions of, 280-281
  - sociopolitical environment affecting, 267-268
- PAPNET system, cost-benefit of, 279-280
  - design of, 271-275
  - evaluation of, 275-278
  - professional reactions to, 280-281
- Pathologist's workstation. See *Workstations.*
- Peltier cell, in charge-coupled devices, 168
- Performance, in telepathology, 247, 258-259
- Phase-contrast microscopy, 299-301
- Phosphor(s), in color displays, 182-183
- Phosphor imager, 170
- Photo eyepieces, for optical equipment, 191-192
- Photographs, as teaching tools, versus digital images, 229-230
  - digitizing of, 235, 237
  - microscopic, 198
  - scanning of, 170
- Picture Archival and Capture Systems, 315
- Pixel(s), in analog-to-digital conversion, 233-234
  - in charge-coupled devices, 154-157
  - versus grade, 168
  - in scanning devices, 169-170
- Pixel array cameras, 234
- Planes, imaging, 190-192
- Plasma display panels, 181
- Pointing devices, for workstation, 207-208
- Polarization microscopy, 302-303
- Power supply, for workstation, 210
- Presentation technologies, for images, 185-186, 241-242

- Primary rendered focal plane systems, for imaging, 190-192
- Printing technologies, for image presentation, 186-187, 241  
for workstation, 212
- Prism, in shifted inline color filter systems, 162-163
- Probes, DNA, in fluorescent in situ hybridization, 308-310
- Processors, for workstation computer, 208
- Productivity software, for workstations, 217-219
- Projection systems, for images, 185-186, 240-241
- Pulsed light color cameras, 164
- Radio communication, in data transfer, 215
- Radiology standards, as digital imaging standards precursor, 316-317
- Random access memory, for workstation computer, 208
- Ratio imaging, in fluorescence in situ hybridization, 310
- Reimbursement, for telepathologic consultation, 259
- Robotics microscopy, in telepathology, 249-252
- Sampling interval, image resolution and, 287
- Scanning devices, 168-170  
for Pap smear screening. See *Pap smear screening, computerized.*  
for photographic slides, 235, 237  
for workstation, 211-212
- Screening, automated, of Pap smears. See *Pap smear screening, computerized.*
- Sectioning, optical, confocal microscopy and, 310-312
- Security, in patient data transfer, 215, 224
- Shade distinction, in image output, 176
- Shifted inline color filters, for charge-coupled devices, 162-163
- Signal averaging, in imaging, 167
- Silicon intensified charge-coupled devices, 165-166
- Slides, photographic, as teaching tools, digitizing of, 235, 237  
versus digital images, 229-230  
scanning of, 170
- Software, for pathologist workstation. See *Workstations.*
- Sound, for workstation computer, 210-211
- Stains, for fluorescence microscopy, 307-308
- Standards, for digital imaging, 315-322  
convergence of, 320  
DICOM in, 317-322  
historical perspective of, 315-316  
international normalization of, 320-321  
radiology standards and, 316-317
- Store and forward systems, in telepathology, 247-248
- Teaching tools, digital imaging as, 229-244  
acquisition of, 231-237  
analog-to-digital conversion in, 233-234  
cameras for, 234-235  
display of, 240-241  
file storage and management, 237-240  
input devices for, 231-233  
output devices for, 233, 240-242  
presentation of, 241-242  
resources for, 242-243  
scanning equipment for, 235, 237  
versus photographic slides, 229-230
- Teleconferencing, video images in, 222, 239
- Telepathology, 218, 256-261  
confidentiality issues in, 256-258  
current status of, 248-249  
diagnostic accuracy of, 253-254  
historical review of, 246-247  
hybrid imaging systems in, 248  
image compression in, 254-256  
licensure issues in, 259  
networking performance issues in, 258-259  
practice issues in, 252-253  
practice settings for, 249  
radiology prototypes of, 245-246  
reimbursement for, 259  
robotics microscopy in, 249-252  
static versus dynamic imaging in, 247-248  
training for, 256  
user interfaces for, 256  
user performance studies of, 247
- Thin-film transistor liquid crystal display panels, 181
- T-mount, for microscopes, 195-196
- Training, for Pap smear screening, 265-266  
for telepathology, 256
- Transmission light microscopy, 198, 299-301
- Trinitron system, for color image display, 181-185
- Trio-dot system, for color image display, 181-185
- Two-photon counting, in confocal microscopy, 312
- Video cameras, 211

- Video cameras (*Continued*)  
 in teaching tool production, 231–234  
 in telepathology, 238  
 lighting optimization for, 196–198
- Videoconferencing, 222, 239
- Videodisc drives, for workstation, 210
- Vignetting, of images, 192–193
- Visible Light Supplement, to DICOM, 318–319
- Vision, display system compatibility with, 176–181
- Visual aids. See *Teaching tools, digital imaging as*.
- Voice recognition software, for workstation computer, 211
- Web browsers, 223–224, 241
- Wells (pixels), in analog-to-digital conversion, 233–234  
 in charge-coupled devices, 154–157  
 versus grade, 168  
 in scanning devices, 169–170
- Wintel operating system, 204–205
- Workstations, electronic equipment for, 201–228, 204–213  
 barcode readers, 212  
 central data storage and, 209  
 components of, 202–203, 226  
 confidentiality in, 224  
 configuration of, 226  
 connectivity with other locations, 213–215  
 definition of, 203  
 desktop versus portable, 205–206  
 disk drives bus, 208–210  
 displays, 206  
 e-mail, 220–221  
 evolving nature of, 202–203  
 expansion bus, 207  
 groupware, 221–222  
 image editing, processing and analysis software, 218  
 Internet, 219–220  
 local system client software, 216–217  
 manufacturer selection for, 203–204  
 microphone, 211  
 operating systems, 215–216  
 output devices, 212–213  
 pointing devices, 207–208  
 power supply protection in, 210  
 printers, 212  
 processors, 208  
 productivity software, 217–219  
 random access memory capacity of, 208  
 resources for, 224–227  
 scanners, 211–212  
 security in, 224  
 sound features, 210–211  
 telepathology capability, 218  
 variable needs for, 202–203  
 video cameras, 211  
 voice recognition systems, 211  
 Web browsers, 223–224
- World Wide Web, 223–224, 241