[0108] A multi-spectral component laser light source system 380 is illustrated in FIG. 7C. In this system, a tunable wavelength IR laser 382 produces IR light that passes through an optional frequency multiplier 384 and into a shutter and power meter 386. The shutter and power meter can be controlled to modulate the intensity of the IR light and also to control whether it is applied to the proximal end of an optical fiber 402 that leads into a patient's body. Alternatively, tunable wavelength IR laser 382 can be frequency multiplied to emit shorter wavelength light. In addition, a green laser 388 produces green coherent light that passes through one of a plurality of shutters 390, while a blue laser 392 produces blue coherent light also controlled by a shutter 390. Similarly, a red laser 396 produces red coherent light. A plurality of dichroic reflectors 394 are used to convey the light from the various laser sources through a lens 398, which focuses the light into a tapered hollow glass tube 400. The angle of the taper of the tapered hollow glass tube is such that internal reflections on its inner surface cause the light from each of the laser sources to be "funneled" into the proximal end of optical fiber 402. The funneled light of combined wavelengths can be transferred to a solid core or hollow core optical fiber for delivery to the tissue in the ROI at the distal end of the optical fiber. Although the light from each of the laser sources might well be of relatively high intensity for therapeutic or diagnostic purposes, tapered hollow glass tube 400 is easily capable of combining the high powered signals from the laser sources. Further details of the hollow glass funnel are provided in a paper entitled "Ultraviolet, Visible, and Infrared Laser Delivery Using Laser-To-Fiber Coupling Via a Grazing-Incidence-Based Hollow Taper," by I. Ilev and R. W. Waynant, from the proceedings of the EOS/SPIE/ELA European Biomedical Optics Week—EbiOS 2000, Amsterdam, the Netherlands, Jul. 4, 2000. This paper will also be published in 2001 as Volume 4158 of the "Proceedings of the SPIE, Biomonitoring and Endoscopy Technologies." Also see "Uncoated Hollow Taper as a Simple Optical Funnel for Laser Deliver," by I. Ilev and R. W. Waynant, Review of Scientific Instruments, Vol. 70, No. 10, pp. 3840-3843 (1999).

[0109] Functional Block Diagrams

[0110] FIG. 8 illustrates the variety of functions that can be carried out with the present invention. Functions such as diagnosis, therapy, and monitoring are shown in blocks that are formed with dash lines, while solid lines are used for imaging functions of a system 410. As illustrated therein, imaging lasers 412 produce light that is directed into a patient's body and through imaging optics on the scanning optical fiber. Furthermore, diagnostic, therapeutic, and monitoring lasers in a block 416 that are controlled by a remote optical switch and attenuators in a block 418 produce coherent light conveyed through an optical coupling mechanism 420 to additional optical components 422 disposed inside the patient's body. RGB photon detectors 430 respond to light received from the ROI, producing an electrical signal that is conveyed through electrical conductors to instrumentation disposed outside the patient's body. Alternatively, the RGB light can be conveyed through optical fibers to external photon detectors 426 or to other types of optical detectors 424 that include, for example, photodiodes and related circuitry. As indicated in a box 432, the system may include additional high or low power UV, and/or visible, and/or IR detectors associated with collection optical fibers for use by one or more spectrophotometers or spectrum analyzers. For example, spectrophotometers and spectrum analyzers indicated in a block 434 can receive light conveyed through light collection optical fibers and/or as signals conveyed over conductors as indicated in a block 436. The system may include additional photon detectors disposed inside the patient's body as a further option. Signals are exchanged bi-directionally between block 432 and 434 and a computer workstation and data acquisition component in a block 440. The computer workstation can execute algorithms that provide for non-linear scanning patterns and control algorithms and also can be programmed to carry out intensity data acquisition, image mapping, and storage of data. In addition, tasks including real-time filtering (e.g., correction for motion and scanner artifacts), real-time determination of ratios and background subtraction, deconvolution, pseudo-stereo enhancement, and processing of the signals produced by the various detectors are implemented by the computer workstation. Signals provided by the computer workstation are output to image display devices and data storage. The image display devices may include cathode ray tube, liquid crystal displays, and HMD devices or other types of stereographic displays, as noted in a block 442. The integrated single fiber system can be applied more easily in future minimally invasive telesurgical and robotic procedures, because of its ability to convey 3D views and to enable a hands-off operation. Since commercially available displays for MIMPs require rectilinear video format, any non-rectilinear optical scanning patterns must be stored in data buffers (memory) and converted to the standard raster scanning format for the display monitors, to make use of the many advantages of non-rectilinear scanning, (such as a simplified single actuator, cylindrical scanner size, and lower scanning rates). This additional step in signal conditioning and remapping is technically trivial with programmable memory devices.

[0111] In addition, image analysis software for carrying out spectral and multivariate analysis and for locating and calculating the limits of regions of interest are carried out using the computer workstation or other computing device. In regard to the ROI, the computations may determine its distribution, boundary, volume, color, and optical density, and based upon the data collected from the ROI, can determine a tissue disease state, medical staging, as well as calculate and monitor therapeutic dosage. All of these functions are indicated in a block 444, which may use the normal imaging computer workstation of block 440. Block 444 is coupled to a block 446, in which additional interactive displays and image overlay formats are provided. Associated with block 444 is a block 448, which indicates that scanner power and control electronics are provided for actuating the electromechanical scanner and for receiving signals from servo sensors in a block 450, which are used for both normal image acquisition and enhancements involved in screening, monitoring, and diagnosis, as well as pixel accurate delivery of therapy.

[0112] Various embodiments of optical fiber scanning actuators have been described above. A block 454 indicates that provision is made for manual control of the distal tip of the scanning optical fiber, to enable the optical fiber to be inserted into a patient's body and positioned at a desired location adjacent an ROI. The manual control will include a turning device and servo sensors, as indicated in a block 456 to facilitate the introduction of the scanning optical fiber at