Optical coherence tomography basics pdf

Optical coherent tomography (OCT) is a imaging method that works like ultrasound simply by using light waves instead of sound waves. Using time latency information contained in light waves that were reflected from different depths within the sample, the OCT system can reconstruct the deep profile of the sample structure. Three-dimensional images can be created by scanning the side beam light beam across the entire surface of the sample. While lateral resolution is determined by the size of a light beam spot, the depth (or axial) resolution depends primarily on the optical bandwidth of the light source. For this reason, OCT systems can combine high axal resolutions with large field depths, so their primary application included visualizing vivo through thick areas of biological systems, especially in humans. The technique has already become installed as a standard imaging mechanism for eye visualization, with numerous commercial tools on the market. The use of OCT imaging in other biomedical areas such as endoscopic imaging of the gastrointestinal and cardiovascular systems is now an active area of research. Section 2. Technology has two main categories of OCT devices: Time-Domain OCT (TDOCT) and Spectral-Domain OCT (SDOCT). TIME-Domain OCT technology is more intuitive to understand, and the earliest research and commercial instruments were based on this technology. Spectral-Domain OCT quickly replaces Time-Domain technology in most applications because it offers significant benefits in image sensitivity and speed. Section 3. Time-Domain OCT (TDOCT) Fig. 1 shows a schematic diagram of the basic TDOCT installation based on fibers. Michelson's interferometer separates light from a broadband source into two ways: reference and sample weapons. The reference hand is terminated by a mirror, which can be scanned in a bye direction; in the hand of the sample, the light is weakly focused in the sample. The interference signal between the reflected reference wave and the lost wave of the sample is then recorded. The method's ability to optical section is due to the following reason: because light is emitted from a broadband source (a large range of optical wavelengths), a strong interference signal is detected only when light from the reference and model weapon has passed the same optical distance. In particular, coherent intervention occurs only when optical patches differ less than the length of the coherence of the light source, the amount inversely proportional to the optical bandwidth. The act of translation (axial scanning) of the reference hand reflector is equivalent to the optical section of the sample, allowing for an optical reflective map from generation compared to the depth. Cross-scanning the sample (to build two- or three-dimensional tomography image) is achieved by rotating a sample of the hand galvonometer mirror. Figure 1. TDOCT System Scheme Section 4. Spectral-Domain OCT (SDOCT) Fig. 2 shows the basic installation of SDOCT based on fibers. Most components are identical to time-Domain. The key difference is that the SDOCT system fixes the length of the reference arm. Instead of obtaining information about the depth of the sample by scanning the length of the reference arm, the output light of the interferometer is analyzed using a spectrometer (hence the term Spectral-Domain). You can show that the measured spectrum of interferometer output contains the same information as the axial scan of the reference hand. The optical reflectivity map compared to the depth is derived from the interferometer output spectrum using Fourier Transform. Special implementation of SDOCT, shown in rice. 2, also commonly referred to as frequency-domain oct (FDOCT). Another version of the SDOCT uses a wave-tuned laser to quickly sweep through a range of wavelengths, allowing the interferometer exit spectrum to be recorded sequentially using a single detector. This method is called Swept-Source OCT (SSOCT) and is particularly interesting for OCT systems running at wavelengths longer than 1 micrometer, where FDOCT will require expensive InGaAs image sensors. Figure 2. The SDOCT OCT scheme can be directly compared to alternative methods in terms of several different criteria: resolution, image depth, acquisition time, complexity, and sampling intrusiveness. As for the first two, OCT occupies a niche represented in rice. 3: Its image depth is usually limited to a few millimeters, less than ultrasound, magnetic resonance imaging (MRI), or X-ray computed tomography (CT), but its resolution is greater. This comparison is reversed with regard to confocal microscopy. Like ultrasound, the time of acquiring OCT is short enough to support tomographic images at video rates, making it much more tolerant of subject motion than a CT or MRI. It does not require physical contact with the sample, and can be used in air-filled hollow organs (as opposed to ultrasound). OCT uses non-ionizing radiation at biologically safe levels, allowing for long-term exposure, and its level of difficulty is closer to ultrasound than to CT or MRI, allowing for the implementation of inexpensive portable scanners. The dot nature of octo technology allows it to be implemented in fiber optics, which makes endoscopic and catheter imaging possible. Figure 3. Comparing oct resolution and image depths with the depths of alternative methods; The length of the pendulum represents the depth of the image, and the size of the sphere is the resolution of section 6. Recent events Recent events in the field included themselves sources of extremely wide bandwidth, primarily based on the generation of supercontinum in various forms of optical fiber, but also using incandescent sources, to achieve a decreased resolution of about 1 micrometer. (Standard current-generation semiconductor sources typically reach a resolution of about 10 micrometers.) The benefits of polarizing images are being realized; selective birifring (phase-speed dependence on polarization) and diocism (the dependence of amplitude on polarization) are used as contrast mechanisms. Section 7. Oct's OBEL OCT research at OBEL is broad, covering theoretical modeling, experimental fundamental-level research, system design and implementation, software development and clinical measurements. Section 8. References by D.D. Sampson, T.R. Hillman, Optical Coherent Tomography, Lasers and Modern Optical Techniques in Biology, G. Palumbo and R. Pratesi, eds. 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Optical Coherent Tomography (OCT) (Stratus OCT, Carl Seiss Meditek, Inc., Dublin, California) (Figure. 10.1) is a commercially available computer high-precision optical tool that generates cross-image (tomograms) of eye structures with almost 10th axial resolution.1 This technology is evolving, and its axis resolution is reportedly higher than 3 microns in laboratory conditions (ultra-high resolution OCT).23 Optical coherent tomography is similar to B-ultrasonic mode. that it uses light, not sound. Unlike ultrasound, OCT does not require contact with the tissue studied. Optical coherent retinal tomography of the neural fiber layer of the optical nerve head of the retina thick macular thickness These keywords were added by the machine, not the authors. This process is experimental and keywords can be updated as the learning algorithm improves. This is a preview of the content of the subscription, log in to check access. You can't show a preview. Download the PDF PREVIEW preview. 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