

19. The Erlangen micro-lightguide spectrophotometer EMPHO I.

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1: Phys Med Biol 1989 Dec;34(12):1883-900

The Erlangen micro-lightguide spectrophotometer EMPHO 1 was designed for fast diffuse reflection (remission) spectrophotometry in small tissue volumes. The aim was to construct a compact, modular instrument with a high repetition rate which can be adapted to moving organs, e.g. the beating heart in situ, by the use of highly flexible micro-lightguides. Focusing problems, which cannot be solved when conventional optical devices such as microscopes are used in moving tissues, become negligible. A bandpass interference filter disk, which is rotated by a motor serves as a monochromating unit. One diffuse reflection spectrum in a selected wavelength domain is recorded during each revolution of the motor. Special filter disks, with spectral ranges of 400-520, 500-630, 600-1200 nm can be used for different tasks. The monochromated light is transmitted by means of a flexible fluid-lightguide to a photomultiplier tube. The electrical signal, which is proportional to the light intensity is recorded by an IBM-compatible AT. An analogue to digital converter has been developed for the AD conversion. Sampling of the spectra occurs in steps of 2 nm triggered by a decoding unit, containing an EPROM where the function between the wavelength-angular position characteristic of the filter disk is stored. A decoder wheel mounted on the same axle as the driving motor is used to program the decoder unit and to recall the wavelength position function. The decoding procedure enables a high wavelength reproducibility to be attained. The monochromating device allows a sampling velocity of 100 spectra per second. The EMPHO I has been successfully applied to experiments in the beating heart, the brain, the eye, the liver, the small intestine and the skeletal muscle of mammals. First investigations have also been performed in the heart during open heart surgery and in human skin. The apparatus has a high sampling rate and the small catchment volume allows measurements of remission spectra in tissue volumes supplied by only a few capillaries. The absolute oxygenation and the relative haemoglobin concentration can be determined by on-line computer evaluation of the recorded spectra and displayed on a screen.

Publication Types:

Review

Review, tutorial

PMID: 2694193 [PubMed - indexed for MEDLINE]