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Albert E Cerussi, Sergio Fantini, Maria Angela Franceschini, and Enrico Gratton.
Frequency-domain lifetime spectroscopy in the multiple scattering regime.
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Abstract
The fluorescence lifetime provides a useful quantitative spectroscopic parameter that is sensitive to the fluorophore local environment. A distinct advantage of the fluorescence lifetime over the fluorescence intensity lies with the independence of the lifetime with respect to the fluorophore concentration. A variety of fluorophores exist that exhibit measurable lifetime changes while in the presence of physiologically relevant analytes such as Ca++ and Mg++, and as a consequence of variations in local environment conditions such as pH. There are many potential applications offered by the fluorescence lifetime's sensitivity in highly scattering environments such as tissues that are not amenable to traditional spectroscopic methods. It has recently been demonstrated that a model for fluorescence spectroscopy in multiple scattering media allows the accurate recovery of fluorescence parameters such as the lifetime. In the frequency-domain an analytic expression for the fluorescence signal has been obtained, whereas in the time-domain an analytical expression cannot be obtained. Using this frequency-domain model, we were able to recover the fluorescence lifetime of a uniformly distributed fluorophore from within a multiple scattering medium. The sensitivity of this method for lifetime determination is also discussed. This work is supported by NIH grants RR03155 and CA57032, and also a joint Whitaker-NIH grant RR10966.