Quantitative and localized spectroscopy for non-invasive bilirubinometry in neonates

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List of symbols

**general**
- \( t \) time
- \( f \) frequency
- \( \lambda \) wavelength
- \( k \) wave number
- \( d \) depth
- \( \varepsilon \) geometrical path length
- \( \Delta \lambda \) wavelength resolution
- \( \Delta k \) wave number resolution
- \( \Delta f \) frequency resolution
- \( h \) photon energy
- \( \varnothing \) diameter
- \( r \) radius
- \( D \) thickness

**optical properties**
- \( \mu_t \) attenuation coefficient
- \( \mu_a \) absorption coefficient
- \( \mu_s \) scattering coefficient
- \( \mu_s^{\text{red}} \) reduced scattering coefficient
- \( \mu_b \) backscattering coefficient
- \( \mu_b,\text{NA} \) NA-corrected \( \mu_b \)
- \( \mu_{\text{eff}} \) effective attenuation coefficient
- \( p(\theta) \) scattering phase function
- \( g \) scattering anisotropy
- \( n \) phase refractive index
- \( n_g \) group refractive index
- \( a \) scattering scaling factor
- \( b \) scatter power
- \( c \) chromophore concentration

**diffusion theory**
- \( I \) spectral intensity
- \( R \) remittance
- \( r_j \) fiber distance from source
- \( z_0 \) modeled source position
- \( z_b \) modeled virtual source position
- \( A \) empirical parameter
- \( \alpha \) proportionality factor
- \( \beta, \gamma \) validity limiting parameters

**LCS signal description**
- \( E_S \) electric field in the sample arm
- \( E_R \) electric field in the reference arm
- \( E_D \) electric field at the detector
- \( I_S \) sample arm intensity
- \( I_R \) reference arm intensity
- \( I_D \) photo detector current
- \( I_{AC} \) AC photo detector current
- \( S \) power spectrum

**LCS system and geometry**
- \( x_s \) sample arm length
- \( x_R \) reference arm length
- \( \Delta L \) optical path length difference
- \( \lambda_0 \) center wavelength
- \( \lambda_{\text{FWHM}} \) wavelength bandwidth
- \( l_c \) coherence length
- \( S_0 \) source power spectrum
- \( T_c \) system coupling efficiency
- \( \zeta \) system calibration constant
- \( \alpha \) scaling factor
- \( \theta_f \) focus position in path length units
- \( Z_R \) Rayleigh length
- \( w \) beam waist
- \( Q \) solid angle
- \( \Theta \) (focusing) angle
- \( M \) number of modes

**LCS acquisition**
- \( \Delta x_s \) sample arm displacement
- \( \Delta x_R \) reference arm displacement
- \( v_R \) reference mirror velocity
- \( f_R \) reference mirror scanning frequency
- \( \Delta R \) reference mirror scanning amplitude
- \( \Delta \varepsilon \) path length scanning window
- \( N \) number of samples
- \( f_s \) sampling frequency

**Brownian motion**
- \( \Delta f_D \) Doppler frequency shift
- \( k_B \) Boltzmann constant
- \( T \) temperature
- \( \eta \) viscosity

**LCS spectroscopic detection**
- \( n_s, n_R \) sample/reference arm fraction
- \( d_{\text{max}}, \Delta L_{\text{max}} \) imaging depth/path length
- \( \delta k, \delta \lambda \) spectrometer pixel width
- \( N_p \) # pixels
- \( \tau \) integration time
- \( f_D \) Doppler frequency
- \( \varepsilon \) detection efficiency
- \( \Delta \varepsilon_R \) reference mirror scanning window
- \( \Delta \varepsilon_D \) spectrograph probing window

(bold-faced printed characters in this thesis denote wavelength dependent parameters)