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
  - \( \mu_b^{\text{NA}} \) NA-corrected backscattering coefficient
  - \( \mu_b^{\text{eff}} \) 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
  - \( E_0 \) electric field at the detector
  - \( I_s \) sample arm intensity
  - \( I_r \) reference arm intensity
  - \( I_0 \) detector current
  - \( I_{AC} \) AC 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
  - \( \xi \) focus position in path length units
  - \( Z_R \) Rayleigh length
  - \( w \) beam waist
  - \( \Omega \) 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
  - \( \Delta L \) 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**
  - \( \eta_s, \eta_R \) 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
  - \( \Delta L_{\text{RA}} \) reference mirror scanning window
  - \( \Delta L_{\text{PS}} \) spectrograph probing window

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