Quantitative and localized spectroscopy for non-invasive bilirubinometry in neonates

Bosschaart, N.

Citation for published version (APA):
### List of symbols

#### General
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t$</td>
<td>time</td>
</tr>
<tr>
<td>$f$</td>
<td>frequency</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>wavelength</td>
</tr>
<tr>
<td>$k$</td>
<td>wave number</td>
</tr>
<tr>
<td>$d$</td>
<td>depth</td>
</tr>
<tr>
<td>$\varepsilon$</td>
<td>geometrical path length</td>
</tr>
<tr>
<td>$\Delta \lambda$</td>
<td>wavelength resolution</td>
</tr>
<tr>
<td>$\Delta k$</td>
<td>wave number resolution</td>
</tr>
<tr>
<td>$\Delta f$</td>
<td>frequency resolution</td>
</tr>
<tr>
<td>$h\nu$</td>
<td>photon energy</td>
</tr>
<tr>
<td>$\phi$</td>
<td>diameter</td>
</tr>
<tr>
<td>$r$</td>
<td>radius</td>
</tr>
<tr>
<td>$D$</td>
<td>thickness</td>
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#### Optical properties
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>$\mu_t$</td>
<td>attenuation coefficient</td>
</tr>
<tr>
<td>$\mu_a$</td>
<td>absorption coefficient</td>
</tr>
<tr>
<td>$\mu_s$</td>
<td>scattering coefficient</td>
</tr>
<tr>
<td>$\mu_s^{\text{red}}$</td>
<td>reduced scattering coefficient</td>
</tr>
<tr>
<td>$\mu_b$</td>
<td>backscattering coefficient</td>
</tr>
<tr>
<td>$\mu_{b,\text{NA}}$</td>
<td>NA-corrected $\mu_b$</td>
</tr>
<tr>
<td>$\mu_{\text{eff}}$</td>
<td>effective attenuation coefficient</td>
</tr>
<tr>
<td>$p(\theta)$</td>
<td>scattering phase function</td>
</tr>
<tr>
<td>$g$</td>
<td>scattering anisotropy</td>
</tr>
<tr>
<td>$n$</td>
<td>phase refractive index</td>
</tr>
<tr>
<td>$n_g$</td>
<td>group refractive index</td>
</tr>
<tr>
<td>$a$</td>
<td>scattering scaling factor</td>
</tr>
<tr>
<td>$b$</td>
<td>scatter power</td>
</tr>
<tr>
<td>$c$</td>
<td>chromophore concentration</td>
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#### Diffusion theory
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>$I_S$</td>
<td>sample arm intensity</td>
</tr>
<tr>
<td>$I_R$</td>
<td>reference arm intensity</td>
</tr>
<tr>
<td>$i_D$</td>
<td>photo detector current</td>
</tr>
<tr>
<td>$i_{AC}$</td>
<td>AC photo detector current</td>
</tr>
<tr>
<td>$S$</td>
<td>power spectrum</td>
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#### LCS system and geometry
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>$x_S$</td>
<td>sample arm length</td>
</tr>
<tr>
<td>$x_R$</td>
<td>reference arm length</td>
</tr>
<tr>
<td>$\Delta L$</td>
<td>optical path length difference</td>
</tr>
<tr>
<td>$\lambda_0$</td>
<td>center wavelength</td>
</tr>
<tr>
<td>$\lambda_{\text{FWHM}}$</td>
<td>wavelength bandwidth</td>
</tr>
<tr>
<td>$l_c$</td>
<td>coherence length</td>
</tr>
<tr>
<td>$S_0$</td>
<td>source power spectrum</td>
</tr>
<tr>
<td>$T_c$</td>
<td>system coupling efficiency</td>
</tr>
<tr>
<td>$\zeta$</td>
<td>system calibration constant</td>
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<tr>
<td>$\alpha$</td>
<td>scaling factor</td>
</tr>
<tr>
<td>$\xi_f$</td>
<td>focus position in path length units</td>
</tr>
<tr>
<td>$Z_R$</td>
<td>Rayleigh length</td>
</tr>
<tr>
<td>$w$</td>
<td>beam waist</td>
</tr>
<tr>
<td>$\Omega$</td>
<td>solid angle</td>
</tr>
<tr>
<td>$\Theta$</td>
<td>(focusing) angle</td>
</tr>
<tr>
<td>$M$</td>
<td>number of modes</td>
</tr>
</tbody>
</table>

#### LCS acquisition
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta x_S$</td>
<td>sample arm displacement</td>
</tr>
<tr>
<td>$\Delta x_R$</td>
<td>reference arm displacement</td>
</tr>
<tr>
<td>$\nu_R$</td>
<td>reference mirror velocity</td>
</tr>
<tr>
<td>$f_R$</td>
<td>reference mirror scanning frequency</td>
</tr>
<tr>
<td>$\Delta R$</td>
<td>reference mirror scanning amplitude</td>
</tr>
<tr>
<td>$\Delta \xi$</td>
<td>path length scanning window</td>
</tr>
<tr>
<td>$N$</td>
<td>number of samples</td>
</tr>
<tr>
<td>$f_s$</td>
<td>sampling frequency</td>
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</table>

#### Brownian motion
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta f_D$</td>
<td>Doppler frequency shift</td>
</tr>
<tr>
<td>$k_B$</td>
<td>Boltzmann constant</td>
</tr>
<tr>
<td>$T$</td>
<td>temperature</td>
</tr>
<tr>
<td>$\eta$</td>
<td>viscosity</td>
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#### LCS spectroscopic detection
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\eta_S$, $\eta_R$</td>
<td>sample/reference arm fraction</td>
</tr>
<tr>
<td>$d_{\text{max}}$, $\Delta L_{\text{max}}$</td>
<td>imaging depth/path length</td>
</tr>
<tr>
<td>$\delta k$, $\delta \lambda$</td>
<td>spectrometer pixel width</td>
</tr>
<tr>
<td>$N_p$</td>
<td># pixels</td>
</tr>
<tr>
<td>$\tau$</td>
<td>integration time</td>
</tr>
<tr>
<td>$f_D$</td>
<td>Doppler frequency</td>
</tr>
<tr>
<td>$\epsilon$</td>
<td>detection efficiency</td>
</tr>
<tr>
<td>$\Delta \xi_R$</td>
<td>reference mirror scanning window</td>
</tr>
<tr>
<td>$\Delta \xi_S$</td>
<td>spectrograph probing window</td>
</tr>
</tbody>
</table>

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