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Angular Average of Time-Harmonic Transport Solutions

Guillaume Bal, Alexandre Jollivet, Ian Langmore & François Monard

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Abstract

We consider the angular averaging of solutions to time-harmonic transport equations. Such quantities model measurements obtained for instance in optical tomography, a medical imaging technique, with frequency-modulated sources. Frequency modulated sources are useful to separate ballistic photons from photons that undergo scattering with the underlying medium. This paper presents a precise asymptotic description of the angularly averaged transport solutions as the modulation frequency ω tends to ∞. Provided that scattering vanishes in the vicinity of measurements, we show that the ballistic contribution is asymptotically larger than the contribution corresponding to single scattering. Similarly, we show that singly scattered photons also have a much larger contribution to the measurements than multiply scattered photons. This decomposition is a necessary step toward the reconstruction of the optical coefficients from available measurements.

Keywords:

Averaged measurements | Forward transport theory | Inverse transport problem | Optimal tomography | Stationary phase | Time-harmonic regime

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