

COMPARISON BETWEEN COUPLED AND UNCOUPLED DIPOLE MODELS FOR SECOND HARMONIC SCATTERING

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Second harmonic images of scatterers of random shapes or of random distributions are difficult to interpret. Second harmonic scattering by a scatterer depends on various factors such as orientation of the scatterer, distribution of the incident field, optical properties of the surrounding medium, and so on. Numerical modeling is one of the simplest ways to address such problems. Moreaux et. al. [1] proposed a phased-array antenna model to describe second harmonic scattering from biological membranes under a focused beam of light. Briefly, this model assumes the scatterer to be made up of an array of antennas or dipoles which oscillate in synchrony with the local incident field but they do not interact with each other. Absence of interaction between dipoles is a serious limitation of this model. We overcame this limitation by taking into account interaction between all the dipoles [2]. Our nonlinear coupled dipole model is an extension of a well known linear scattering model called Discrete Dipole Approximation (DDA) [3].

Here we show how the coupled dipole model compares with the phased-array antenna model. We found that accuracy of the results from phased-array antenna model depends on the polarizability of the scatterer. Coupled dipole model, on the other hand, takes into account polarizability of the scatterer to calculate the resultant second harmonic scattering. Hence coupled dipole model can be applied to study nonlinear scattering from a wider range of scatterers.

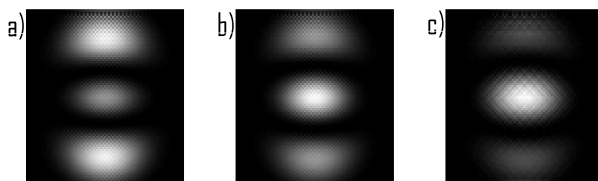


Figure 1. Second order polarization induced in a thin layer of dipoles when excited by linear polarized focused beam of light. Phased- array antenna model (a) gives results independent of the refractive index of the scatterer whereas results from coupled dipole model (b & c) are highly sensitive to the refractive index (1.42 & 1.6 for b & c respectively).

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