Mathematical Analysis of Imaging Modalities using Electric or Magnetic Nanoparticles as Contrast Agents

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In this talk, we are concerned with the mathematical analysis of imaging modalities using electric or magnetic nanoparticles as contrast agents. An electric (resp. magnetic) nanoparticle is characterized by a large contrast of its own relative permittivity ϵ (resp. relative permeability μ) which is of the order $a^{-\alpha}$, with $\alpha > 0$, where a is its relative radius, $a << 1$ (estimated with few nanometers). Several examples of electromagnetic nanoparticles used in medical imaging having such characteristics are reported in the literature. The general idea in such imaging modalities is to collect remotely the data (i.e. the scattered fields generated by incident fields) before and after injecting (or delivering) the nanoparticles in the targeted region. The believe is that by contrasting these data we can recover the inner values of the permittivity coefficients of the tissue in that region. Our goal is to analyze mathematically such ideas by providing quantitative estimates of these coefficients in terms of the collected data.