Interior Intelligence by Networked Sensing, Imaging and Global Hierarchical Tomography (I2NSIGHT)

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Project Summary:

Remote estimation of complex internal building structure is an extremely challenging inverse problem. Microwaves in various frequency ranges are capable of building penetration, but the resulting observations are sensitive to a host of influences, including layout geometry, interior and exterior wall thicknesses and EM properties (dielectric constant, conductivity), existence of doors and windows, and clutter objects within the building. Further, collected data sets will display significant variability depending on source-receiver geometry, as well as antenna design and bandwidth of the probing radiation. The complexity and variability of the resulting inverse problem requires innovations in sensor architecture (adaptivity and cooperation), fusion and estimation (closed-loop model estimation over the vast parameter space alluded to above), sensor design and deployment (sensor mode and form factor, geolocation, optimal CONOPS) and implementation (robustness, fast and practical computing). Our approach exploits our detailed understanding of the physics of microwave propagation to build a model-based, maximum-likelihood framework. It integrates numerous measurement types, and provides criteria for adjustment of sensor collection parameters, for closed-loop estimation of internal structures and people.