Ground-Based SAR Laboratory Investigation of Multistatic SAR Sensing

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ABSTRACT

With improvements in radar technology leading to reductions in sensor cost and increases in efficiency, multistatic Synthetic Aperture Radar (SAR) sensing concepts are gaining in interest, potentially in the form of UAV sensing swarms, or of multistatic SAR satellite constellations. Benefits of these modes may include more regular surveillance monitoring, with the additional SAR geometries available, potentially leading to finer SAR image resolution with possible improvements in interpretability and 3D SAR image formation.

An overview of current multistatic Ground-Based SAR laboratory (GBSAR lab) research is given, which includes sparse multistatic 3D SAR image formation, multistatic Inverse SAR (ISAR) and multistatic interferometry. In some instances measured results deviate from those expected from simplistic simulation models, indicating that predictive models should be enhanced for some applications.

Taking multistatic interferometry as an example, these products are formed with SAR data and can be used to determine Digital Elevation Maps (DEM) or to sensitively detect changes within a scene via SAR Coherent Change Detection (CCD) [1], changes such as vehicle tracks for example. In the CCD process, typically the two radar platform trajectories are closely repeated, with low baseline, for best results. However, for satellites this may necessitate long revisit times which may for example lead to decorrelations due to natural processes such as wind and rain which can reduce CCD interpretability. The ability to utilize antenna platform trajectories with greater baselines (differences) could help reduce revisit times, however potentially such image pairs may not have full coherence. To investigate this, a variety of different bistatic SAR collection were measured for a planar horizontal terrain scene in, with a range of bistatic angles, in such a way as to maintain a substantial K-space vertical projection overlap between collections. Large K-space overlap is conventionally understood to imply a likely high SAR coherence between images, as indicated by isotropic scattering models. However, laboratory measurements have identified that correlation between some large baseline bistatic SAR images have lower than ideal coherence.

REFERENCES

[1] Jakowatz, C.V., Wahl, D.E., Eichel, P.H., Ghiglia, D.C., Thompson, P.A.: 'Spotlight-mode synthetic aperture radar a signal processing approach' (Kluwer Academic Publishers, 1996).