



Synthetic Aperture Radar

Christopher F. Barnes

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Synthetic Aperture Radar, Wave Theory Foundations, Analysis and Algorithms delivers a comprehensive and in-depth study of the subject. This book covers all major topics related to synthetic aperture radar (SAR) science, systems and software. SAR science is established on a foundation of wave theory. SAR systems for stripmap, spotlight, spotmap, volumetric, inverse, scan, swept, etc. modes are explained. SAR analysis techniques are presented at a detailed mathematical level, including analyses of chirp signals, and both stretch and chirp receiver systems. All SAR algorithm classes are presented: Stolt formatting, polar formatting (including direct and filtered back-projection methods), hyperbolic coherent summing, spherical coherent summing (including direct, filtered and factorized back-propagation versions), range stacking, range-Doppler and chirp scaling. Most SAR algorithms are described with sufficient detail to enable software implementations. Novel methods for volumetric SAR (VolSAR) imaging are presented. The empowerment of diffraction limited VolSAR imaging with swarms of SAR sensors and non-linear flight paths is demonstrated in simulation studies. Coherent fusion of multiband SAR is also demonstrated. Vector and scalar wave motion equations based on Maxwell's equations and acoustic wave dynamics are derived. Electromagnetic and acoustic wave theory principles are used to develop SAR signal models for both differential and integral descriptions of terrain scattering and received backscatter. SAR and computed imaging literature of the last sixty years is extensively surveyed and summarized. Relationships between SAR image formation algorithms and the computed imaging algorithms of holography, diffraction tomography, ray tomography and seismology are explained. Many variations of SAR algorithms that can be found in the literature are organized into a taxonomy that illuminates algorithm relationships. #SARWAVE

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