Microlocal Analysis of Synthetic Aperture Radar Imaging in the Presence of a Vertical Wall

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Abstract. Many imaging methods involve probing a material with a wave and observing the back-scattered wave. The back-scattered wave measurements are used to compute an image of the internal structure of the material (in a non-desctructive way usually). Many of the conventional methods make the assumption that the wave has scattered just once from the region to be imaged before returning to the sensor to be recorded. The purpose here is to show how this restriction can be partially removed and also how its removal leads to an enhanced image, free of the artifacts often associated with the conventionally reconstructed image.

We consider Synthetic Aperture Radar (SAR) in which backscattered waves are measured from locations along a single flight track of an aircraft and the target is located nearby a reflective vertical wall.

The forward operator associated to this problem is a Fourier Integral Operator (FIO); such operators map singular distributions to other singular distributions. The relationship between the input and output singularities forms what is called a canonical relation. We study this in details; emphasis is given in particular on the case where it is not possible to form a beam with the radar.

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