Regularization methods to resolution enhancement of remote sensed data

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Earth-orbiting microwave radiometers are a key remote sensing tool to provide valuable and effective large-scale information for oceanic and atmospheric applications. However, there is a growing interest in other applications that require finer spatial resolution. The resolution of radiometer data can be enhanced by using either image-processing techniques or special reconstruction algorithms. These latter do not enhance the resolution of end-products, as done by ad hoc image-processing procedures; rather, once a low resolution measure of geophysical parameters is provided, they attempt to reconstruct the geophysical parameters on a finer grid. To this aim, a linear ill-posed problem needs to be inverted, which can be physically considered as the analog of an antenna-pattern deconvolution. Hence, regularization methods must be accounted for. In literature several methods to enhance the spatial resolution of radiometer measurements have been proposed, e.g. the Backus-Gilbert, the SIR, the Tikhonov regularization, etc. In this talk, two approaches are proposed:

- A truncated singular value decomposition (TSVD) approach is proposed. The rationale that lies at the basis of the TSVD approach consists of truncating the SVD solution to discard the components dominated by noise. The TSVD is properly extended to the 2D case and shown to be very effective when the kernel is a two-dimensional tensor product.

- An iterative reconstruction technique, based on the gradient method in Banach spaces is proposed. Banach spaces are complete vector spaces endowed with a norm that only allows to measure "length" and "distance" between its elements without any scalar product, that is, without measuring any "angle" between them. The technique is shown to overcome the drawbacks of classical Hilbert space

References

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