Detecting Contaminations on a Rough Surface by Factorization

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We consider the inverse scattering problem of detecting a local contamination of a one dimensional rough surface using near field measurements on a finite measurement line above the surface. On the rough surface a Dirichlet boundary condition is imposed and the upward radiation condition ensures well posedness of the direct scattering problem. For the inverse problem, we use the factorization method. Compared to inverse scattering problems in the context of bounded objects the method encounters several complications arising from the unbounded scatterer and the near field measurements. First, the upward radiation condition does not yield positivity of the non self adjoint part of the data operator. Second, complex conjugated – and therefore non physical – point sources have to be used to obtain a suitable factorization. Stated in a different way, in practice the data one needs is not at hand. To tackle this second problem, we apply a recent idea of Andreas Kirsch [1] and express the range of the "conjugate" near field operator by the physical near field operator. Using perturbation theory for collectively compact and pointwise convergent operators we explain why the series criterion of the factorization method can be applied in this situation.

References

[1] A. Kirsch: An Integral Equation for Maxwell's Equation in a Layered Medium with an Application to the Factorization Method, accepted for *Integral Equations and Applications*.