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Conclusion and perspectives

We outlined in the last part of the book that there are various possible applications of the method of approximate inverse in industry and medical imaging. In some cases the method did not only lead to novel and very efficient solvers but allowed also for a detailed convergence analysis. Nevertheless, there are still more applications which have not been discussed in this book at all. A large area of current research are scattering problems. The first publication concerning a reconstruction method for inverse scattering using the method of approximate inverse is ABDULLAH, LOUIS [1]. Here, the authors considered the *Lippmann-Schwinger equation*

$$u(\alpha, x) = u_{\text{inc}}(\alpha, x) - k^2 \int_{\|y\|<R} G(k\,\|x-y\|)\, f(y)\, u(\alpha, y)\, \mathrm{d}y\,, \tag{19.1}$$

where the entire field u is the sum of the scattered field and the incident field, $u = u_{\text{sc}} + u_{\text{inc}}$, k is the wave number, $f(x) = n^2(x) - 1$ with the refractive index n and

$$G(k\,\|x-y\|) = \frac{\mathrm{i}}{4}\, H_0^{(1)}(k\,\|x-y\|)\,, \qquad x \neq y$$

denotes the Green function, $H_0^{(1)}$ is the Hankel function of first kind and order 0. Solving equation (19.1) is equivalent to the inverse problem of recovering the refractive index n from measurements of the scattered field u_{sc}. In [1] this problem is solved by computing reconstruction kernels with the help of the singular value decomposition of the integral operator in (19.1). Improvements and extensions of the method, e.g. for solving three-dimensional problems related to Maxwell's equations, are still under consideration.

Inverse problems will play a role of increasing importance when dealing with questions in industry, natural science and medical imaging and the method of approximate inverse might be a powerful and important tool for finding new ways to cope with these problems.