

MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

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Inverse Problems in Wave Scattering

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ABSTRACT. The workshop treated inverse problems for partial differential equations, especially inverse scattering problems, and their applications in technology. While special attention was paid to sampling methods, decomposition methods, Newton methods and questions of unique determination were also investigated.

Mathematics Subject Classification (2000): 14Q05, 35Rxx, 65Jxx, 65N21, 74Jxx, 78Axx.

Introduction by the Organisers

Since this was only a “half workshop”, the organisers intended to focus on a relatively small number of topics. We selected scattering from an obstacle and with primarily the Maxwell equations as the underlying structure. We also wanted to concentrate on analytic methods where questions of uniqueness and (if appropriate) existence were at the forefront. That is not to say that reconstructive methods were downplayed and in fact almost all of the talks did show some illustrative reconstructions, but greater attention was to the analysis of the methods rather than implementation issues. Even within this structure there was a strong focus on ideas that were in the spirit of *sampling* or *factorization methods*. These techniques work under a wide variety of physical situations and are perhaps optimal when very little is known a priori about the location, shape or material properties of the scatterer and where the most accurate solutions are not required.

The participants were the usual geographical blend but what stood out in looking over the audience was the youthful median age. For many in the group this was their first visit to Oberwolfach and, in some cases, their first time to meet each other. With the smaller number of participants we were able to have a relaxed schedule and yet allow most to speak (about three quarters did so). Thus talks were scheduled for 9:30am, 11am, 4pm and 5pm except for the Wednesday

and Friday when we only had morning talks. The duration was scheduled for a maximum of 40 minutes to allow for comments and discussions (and frequently the additional post-talk questions and comments took us up to the next speaker). We also had one evening session where a relatively new topic (the question of existence and properties of so called “transmission eigenvalues”) was discussed by the whole workshop. Almost all participants attended all the lectures; the exceptions were due to interest in talks from the other workshop. We thus conclude that the format was successful from the perspective of the participants. Another reason for the high attendance was the excellent overall quality of the talks; it is clear that most of the speakers had taken great care over the preparation and there was considerable evidence that talks were modified as the conference progressed in order to present a fresh set of ideas to the audience.

It should be noted that at the last workshop run by the present organisers special sessions were held in the evening. One of these considered some new ideas on one of the oldest conjectures in the area - whether or not a single incident plane wave is sufficient to recover an arbitrary obstacle. There has been a history of partial results, but no substantial progress had been made on the problem for twenty years. Three of the participants at the previous meeting managed to make substantial progress in the year after the workshop. (The conjecture is still unproven in the most general setting but a first result proved the conjecture for convex, polygonal obstacles, a subsequent one removed the need for convexity. These used very different techniques and further progress is expected.) We think that devoting part of the time to look at a specific focused topic has enormous merit at Oberwolfach and we only hope for a similar outcome from the present workshop.

As usual, the service provided by the staff was exemplary. This plays an enormous part in the “Oberwolfach experience” and allows the participants to concentrate on the research aspects.

Finally, we should note that at the previous workshop the organisers complained about the state of current atmospheric modelling/computation leading to an erroneous weather forecast that added a surprise rainstorm to the Wednesday hike. We are sorry to report that the computational geophysicists still have work to do as they were again wrong, but we much prefer a forecast of rain yet in fact receive fine weather.