SURVEY and REVIEW

In a previous issue of *SIAM Review*, I started my introduction to the Survey and Review section by saying that it is safe to bet that most readers use matrices in their work. I would also safely bet that most readers have used the (discrete or continuous) Fourier transform at some point, since, for reasons I have not yet completely understood, Fourier techniques appear in all kinds of unrelated areas of applied mathematics, including many where there is no apparent connection with sinusoidal functions. The paper that follows, "Phase Retrieval: Uniqueness and Stability," by Philipp Grohs, Sarah Koppensteiner, and Martin Rathmair, studies the problem of recovering a function $f(x)$ from the knowledge of the magnitude $|\widehat{f}(x)|$ of its Fourier transform $\widehat{f}(x)$. In applications, including quantum mechanics, astronomy, radar, and speech recognition, this problem has been very relevant for a long time. The most salient application is in the field of diffraction imaging, where one tries to determine an object from diffraction patterns. The study of the structure of crystals by x-ray diffraction got von Laue the 1914 Nobel Prize in Physics, and since then there have been at least another 11 Nobel Prizes related to diffraction imaging.

The paper has three sections in addition to the introduction. Sections 3 and 4 are, respectively, devoted to the discrete and continuous Fourier transforms. Section 2 presents a general theory of phase retrieval and successively addresses two questions: (i) to what extent may a function f be recovered from the knowledge of the magnitude $|Tf|$, where T is a linear transformation, and (ii) if the recovery is possible, what happens when $|Tf|$ undergoes small perturbations?

Since the material has many useful applications and is related to a number of different branches of applied mathematics, it will be of interest to a wide range of readers.

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