Hanson in *Paterns of Discovery* (1958), and by Thomas Kuhn in *The Structure of Scientific Revolutions* (1962). As evidenced by the controversy that still swirls around the latter work, the extent of the role of metaphysics in science is exceedingly difficult to determine.

It is not beyond the realm of possibility that the conscious or unconscious prejudices that Jaki—a Benedictine priest—deplores in scientific research have, consciously or unconsciously, crept into his own historical research. Although the result enlivens the work, the reader should beware that the history of science may be no less controversial than science itself. In the end the reader comes away from the book with an appreciation of the problems in the field. And, unsatisfactory theories notwithstanding, we live in an era when the truth may soon be known about the actual existence of the planets, if not the planetarians.

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Linear Systems, Fourier Transforms and Optics

J. D. Gaskill
554 pp. Wiley, New York, 1978. $24.95

The Fourier transform has won an important place as a point of departure into many branches of physics, branches as diverse as waves, electric circuits, quantum mechanics, probability and even computation. Consequently transform methods have earned increasing attention in late undergraduate and early postgraduate courses. Indeed the Fourier transform is one of the few links that electrical engineers have in common, now that it is perfectly possible to receive a PhD in information science or computer science without encountering electromagnetic theory. So the role once played by James Clerk Maxwell has now partly been handed on to Joseph Fourier.

Optics is one of the fields that is rewardingly explored with transforms. For example, although geometrical ray tracing through lenses is rather separate, lens design as such is certainly one of the topics that has benefited. The by-now familiar modulation transfer function or MTF, which describes the fidelity of transmission of spatially sinusoidal patterns through a linear-optical system, is the same thing (in a higher dimensionality) as the hi-fi-amplifier response curve that we all desire to have as flat as possible up to a roll-off frequency that is as high as possible. Clearly the MTF as a tool for thinking with optical systems is superior to the old-fashioned resolving power stated in lines per inch. The optical transfer function, of which the MTF is merely the modulus, is even better. The recent introduction of Fourier concepts into optics has been via electrical engineering just as Jack Gaskill is himself an electrical engineer by origin and is now Professor of Optical Sciences at the University of Arizona. Of course, Fourier concepts always existed in some corners of optics—witness Michelson's Fourier spectroscopy and Abbé's theory of image formation in the microscope.

What Gaskill has done is to provide a textbook that combines the background of linear-system theory and the necessary skills of manipulating Fourier transforms and convolutions that are relevant to image formation in optics. The emphasis on two-dimensional things is unusual in system-theory texts but of course exactly what is wanted for imagery.

A very readable book is the result. Gaskill has given much care to presentation, his illustrations are clear and he devotes plenty of comfortable digression to the whys and hows. Although equations appear on practically every page, the content is not at all forbidding.

Gaskill, who shares with me an interest in notation as a means to clarity, makes free use of rect x, comb x (for an infinite string of unit impulses) and other similar examples in current use including sinc $x \equiv (\pi x)^{-1} \sin \pi x$, whose definition he attributes to me. I have to report that I got it from P. M. Woodward. Gaskill innovates freely but transparently as with cyl x, the unit cylinder function, and somb r, the "sombrero" function known elsewhere as jinc $r \equiv (2r)^{-1} J_1(\pi r)$, the circular relation to "sinc." Just as the "sinc" function is the function that contains cosine components of all frequencies up to a certain cutoff with equal amplitude and nothing beyond, so the "jinc" function, or, in Arizona, the "sombrero" function, contains spatial cosine components (corrugations) of all frequencies up to a certain cutoff, with equal amplitude in all orientations. These apparently *ad hoc* inventions come into their own when "rect" and "sinc" prove to be Fourier transforms, "comb" is its own Fourier transform and "cyl" and "jinc" are a Hankel-transform pair. The utility of these standardized functions has been well established in the fields of conversation, of reasoning out problems in your head and of writing readable algebra.

In the last third of the book Gaskill treats optical subjects using the tools developed. Fresnel diffraction, which comes first, is a simple phenomenon in terms of Fourier analysis. First there are the spatial frequencies comprising the aperture distribution, assumed given, that attenuate exponentially without change of spatial phase. The other spatial frequencies propagate without any attenuation at all, each with its appropriate angle of incidence. Thus the diffraction pattern on any plane parallel to the aperture is deducible by reassembling the spatial components with spatial phase shifts corresponding to their angle of incidence. Beyond the point where evanescent waves count, Fresnel diffraction consists merely of a systematic rearrangement of the Fourier components without change of amplitude. Naturally each pattern on each successive plane thus has the same spatial autocorrelation function, a simplicity that is not as readily apparent from the Huyghens approach to diffraction. The discussion passes easily over into Fraunhofer diffraction, where each nonevanescent spatial frequency in the aperture is sorted out ultimately into one direction (its incident direction). Much discussion about lenses, imaging and coherent and incoherent light then ensues with interpretation in terms of linear filters. Finally, an appendix on elementary geometrical optics helpfully exposes the arcane nomenclature that distinguishes the expert from those who do not know the difference between an aperture stop and an exit pupil.

Numerous problems and literature references accompany each chapter. Originating from a distinguished center of optical knowledge, this book will prove welcome in courses on optical design or for self study and will contain much of interest for readers in other fields where two-dimensional images are treated.

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book notes

Collision Spectroscopy. R. G. Cooks, ed. 458 pp. Plenum, New York, 1978. $44.50

Collision Spectroscopy, according to its dustjacket description, "focuses on the underlying unity of disparate studies of mass spectrometrists concerned with the structures of organic ions, those of chemical physicists concerned with inelastic collisions of simple species, and those of physicists on the theory of atomic collisions." The chapters are generally arranged in order of increasing complexity—atomic, diatomic and polyatomic systems and collisions involving excitation, charge change and dissociative excitation.

Cosmic Dust, J. A. M. McDonnell, ed. 693 pp. Wiley-Interscience, New York, 1978. $67.00

Cosmic Dust is a up-to-date review of the major fields of study of solid matter in the solar system and the galaxy. Thus the book contains chapters on comets, zodiacal light (an indicator of interplanetary dust), meteors, interstellar dust and lunar and planetary impact erosion. Additional chapters cover microparticle