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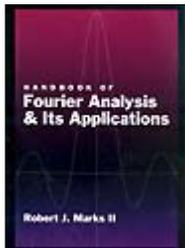
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Handbook of Fourier Analysis and Its Applications

Robert J. Marks II



Publisher: Oxford University Press (2009)

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[Reviewed by Michael Berg, on 05/25/2009]

This is a titanic work of 772 pages, covering, in the main, the parts of Fourier analysis pertinent to modern applications such as signal and image processing and other latter-day mainstays of electrical engineering. This is indeed one of the first things one notices leafing through the book, what with a profusion of "before-during-after" picture panels populating the book's middle pages, all to great effect: there is no doubt that the author is on top of the latest things along these lines.

This extremely valuable *vademecum* (well, it's a bit big for that, I guess...) starts off with a pretty thorough development of the foundational material in Fourier analysis as today's electrical engineers would have it. Coincidentally I just had occasion a few months ago to serve on an EE Search and Hiring Committee at my university and was treated to their way of doing Fourier analysis *via* several job candidates' trial lectures: *j*'s instead of *i*'s and hand waving instead of proofs, but nonetheless effective stuff, given that, after all, the circuits these folks build have to work. I must say that I came away with a measure of respect for their handling of Fourier analysis, even if I'd rather run barefoot through broken glass than go that route myself: $\sqrt{-1} = i$, regardless of what they tell themselves, and what they do to Dirac's δ -function (or distribution) defies description. But it's very good stuff in its own way, and Marks' *Handbook* certainly does their version of the subject justice. To boot, he puts in proofs where appropriate, provides exercises, and does other such things to make at least part of the *Handbook* usable as a text.

Along these lines, then, Marks says that his audience is "practitioners rather than mathematicians," and that his ideal reader should have an introduction to Fourier analysis already under his belt. And then "at least four courses" can be served by the book: an introduction (to some of the more sophisticated material, to be sure), multidimensional signal processing, Shannon sampling and interpolation theory, and "advanced topics" in Fourier analysis (including stuff on e.g. Heisenberg's uncertainty principle). It's my outsider's impression that this is on the money: Marks even gives the reader (or professor) a flow-chart as regards how to proceed. Hence the 722 pages.

But be forewarned, the engineers' rules are in place: "little attention is given to the status of the Dirac delta as a distribution rather than a function [I told you so!], or the need for measure theory in the formulation of Hilbert spaces [Fair enough: I've taught enough engineers over the years to be able to sympathize.]. Likewise absolute convergence in infinite sums (integrals) is a requirement for interchanging the order of summation (integration) but is not invoked in every instance. The question of 'When can we interchange the order of integration?' has herein an answer of 'always.' Rigorously, this is of course not true. However, in the rare case where such a switch is inappropriately made, the math, by becoming ludicrous or inconsistent, will often

communicate the error. [Let's hope so ...] Although we point to the availability of mathematical rigor in most cases, meticulousness is not painstakingly applied [Let them be anathema!]. [Now gird your loins:] Doing so would mask recognition of the beautiful forest with the distraction of small pesky trees ..." Makes you chafe, doesn't it?

Thus, factoring in the engineering bias, *Handbook of Fourier Analysis and Its Applications* is obviously a valuable and worthwhile contribution --- for electrical engineers, mathematicians who have to deal with them in a real-world professional way, and possibly a stray mathematician interested in how this part of the real world functions. I think Marks' book is a very good one, quickly putting on my ecumenical "some of my best friends are electrical engineers" hat. But it's not pure mathematics — but then: it certainly doesn't claim to be.

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