creating new knowledge and training people. A prestigious research university is clearly a key to the kind of high-tech prosperity that Massachusetts enjoyed in the mid-1980s, but it is only a necessary, not a sufficient, condition. While Harvard is perhaps the most famous university in the US, one infers from the book that its role in high-tech growth was small and that engineering-oriented MIT was the more significant ingredient.

As the title implies, the book is focused very strongly on the Boston area. And readers from other places may find the Massa-centric viewpoint somewhat grating. But it would have been interesting to see comparisons with other areas of the country that have enjoyed high-tech booms, such as Silicon Valley, the Long Island–New Jersey area or southern California (with Caltech and the Jet Propulsion Laboratory).

Route 128 will make interesting reading for planners, economists, academic researchers, politicians, historians and venture capitalists.

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Basics of Interferometry

P. Hariharan
Academic, San Diego, Calif., 1992. 213 pp. $39.95 hc
ISBN 0-12-32518-0

Basics of Interferometry is a good introduction for scientists and engineers who understand basic optics and need to use interferometry or interferometers. This book packs a lot of information into a short volume. The descriptions provided by P. Hariharan are concise and easy to understand. In addition, he provides illustrative examples for major concepts, and to help solidify the concepts he includes problems with detailed answers.

The topics discussed include basic interference, two-beam interferometers and multiple-beam interference, as well as light sources and detectors. Hariharan introduces various applications of interferometry in sections on the measurement of length, optical testing, digital interferometry techniques, holographic and speckle interferometry, interferometric sensors, interference spectroscopy and Fourier-transform spectroscopy. For each application the author describes a specific interferometer configuration. Each section of the book also provides practical advice to help the reader decide which technique is best for a given application. Hariharan also discusses whether to buy or build an interferometer. The last 50 pages of the book are appendices that provide good references on basic concepts, interferometer adjustment and the evaluation of interferograms.

Hariharan has extensive experience in interferometry, optical testing and holography and is well qualified to write a book of this type. Although he has written more detailed books on interferometry and holography, this book is the most useful one for those who work with interferometers. Because this book is not geared toward the specialist, it can serve as the text for an introductory course in interferometry. It can also serve as a good reference.

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Active Control of Sound

P. A. Nelson and S. J. Elliott
Academic, San Diego, Calif., 1992. 436 pp. $129.00 hc
ISBN 0-12-515425

The idea that noise may be reduced by machine-made silence is no longer confined to science fiction. The first patent for a "process of silencing sound oscillations" was granted to Paul Lueg in 1936, some 20 years before its time. By 1953 electronics had developed to the point where the construction of an "electronic sound absorber" was feasible. By 1970 several elaborate schemes to suppress sound electronically were invented, and by 1980 these schemes were realized in high-technology practice, a practice made possible by the phenomenal advance in digital electronics. After a faltering start, commercial developments in active sound control are occurring now—described in publications too often aimed at promoting commercial positions rather than scientific advance. There has been an explosive growth in the number of papers published and the variety of examples reported, but there has been no authoritative reference text on active sound control—until now. Phil Nelson and Steve Elliott, who have been responsible for so many of the subject's successful technical advances, have written a most important text, which brings both the underlying theory and practical technique within clear reach of their intended audience: students in acoustics and signal processing, professional acoustical and electrical engineers and researchers studying active sound control.

Active techniques bring to noise control a new order of scientific method. They are different from—and will enhance rather than displace—passive technology, which includes avoiding the overlap of modal frequencies, damping out any resonances and eliminating rattles, noise shorts and obvious sources of vibration. Current passive techniques concern incoherent sounds, whose energies add to the noise of the whole. But active methods exploit interference between coherent sounds, with the controller working to maintain the strength and phase for destructive interference. Energy addition of incoherent sounds has no relevance to this case, and there is nothing to justify the intuitive expectation that two sounds are louder than one; when precisely matched, they cancel each other.

The subject has little room for approximate procedures and loose thinking. Errors quickly destroy the delicate cancellation. As a subject active sound control has much in common with applied mathematics, precision and rigor being essential to both fields. The theoretical side of acoustics and the control branch of electrical engineering are the subject's core disciplines, and it is a good feature of this book that its first quarter is devoted to familiarizing the student with the essential notions of both. The authors do this by treating simple special cases in great detail (implying a generality beyond what is strictly justified) and by giving references that provide proof that practical cases display the same underlying features. This approach encourages the use of these ideas in practical situations too intricate for comprehensive analysis. And although the extrapolation will occasionally fail, the number and variety of successfully treated cases justify the approach. The book certainly introduces the main concepts in a clear and concise way.

The authors treat sound as pressure variations linearly related throughout space and time to prescribed source activity and boundary conditions. Transducers monitor the sound and produce the signals to be processed for driving the secondary sources that generate the canceling field. What is feasible within the causality constraint is the main question addressed under the heading "Linear Systems". The summary of digital filter design and scope that concludes the basic material in this section enables one to understand the workings and construction of reported active sound suppressors. The main material of the book follows this introduction, giving theoretical con-

cepts and descriptions of the principles underlying controllers that have already been implemented. The book also covers theoretical ideas for the manipulation of global sound fields, which seem to me to be overly elaborate and futuristic; only that section lacks the assurance that comes from the feeling that the authors really know what they are talking about because they have actually done it.

The book's emphasis on acoustical energy and energy flux is a little distracting, because their significance for incoherent fields has little relevance to active methods. I would have preferred to see enclosed fields treated more generally than is possible in the "rectangular box" geometry. But more typical of the book is the straightforward and jargon-free coverage of successful cabin noise controllers. The clear, well-written and informative coverage of this and other topics makes the book a joy to read.

This book is essential reading for those participating in the technology of antisound, a technology that can work where other methods fail. That aspect should give the subject a bright future, a future brought closer by the clarity of *Active Control of Sound.*

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