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REVIEW

Design Theory of Fluidic Components. By J. M. KIRSHNER and S. KATZ. Academic Press, 1975. 479 pp. £21.60 or $45.00.

Kirshner and Katz have been immersed in fluidics since its birth at the Harry Diamond Laboratories and their experience is reflected in this book, which concentrates on theory and draws selectively on the extensive wake-flow of literature which accompanies the technology. The scope is made clear in the introductory pages. It is not a design manual, it is aimed at researchers. The 'fluidic components' are primarily those which control information either in analog or digital form; only brief consideration is given to devices for process-fluid handling of high-power modulation. The province is that of miniature systems operating mainly with air at near-ambient conditions in a regime where changes in Reynolds number, Mach number and viscous damping have a significant influence.

The first half of the book describes non-amplifying components. Information is given concerning the pressure loss in various duct configurations. Diodes are briefly mentioned including a strictly limited inviscid analysis of a vortex (Thoma) diode. The egregious Tesla diode also features; it should be noted that a simple conical diffuser acts as a better diode. Useful data are given concerning capacitance due to gas compression during the transition from isothermal to adiabatic conditions.

Chapter 3 and the five appendices concern fluid transmission lines. Starting with the basic characterizing parameters, the description progresses logically from small-signal transmission in lines with circular and rectangular cross-sections to large-signal methods in the final section. Exact line response formulae are unwieldy, being typified by a proliferation of Bessel functions with fractional complex arguments. Therefore, an important aspect of this topic is the extraction of usable data and valid approximations. This is extensively covered with descriptions of identical–T-section lumping, sum and product series expansions, solutions for specific ranges of Stokes number and other approximations useful with rectangular lines. Later on, the quasi method of characteristics is described for determining large-signal response. The necessary weighting factors are tabulated in the appendix. Tabulated data for circular and rectangular lines and Fortan programs for small and large signal line response are also given.

Subsequent chapters concern the confined interacting flows that provide amplification. The theory is largely based on piecewise modelling of various regions followed by an amalgamation of the more-or-less independent results. Typical of the procedure is the use of a carefully chosen free-jet model to describe a jet near a wall and the subsequent incorporation of this into an amplifier model. The output of a ventral device can be calculated from the integrated intercepted dynamic pressure and the output resistance treated as independent

quantities. Hence empirical coefficients and judicious choices are abundant. The theory serves mainly as an interpolation procedure valid for tested ranges of operation and configuration but one cannot expect any great predictive capability for radically new designs. It is, however, hard to suggest alternatives; finite-difference modelling, for example, would undoubtedly be more costly and less accurate than experiment. In any case, these methods have helped in the evolution of greatly improved proportional amplifiers and in the rationalization of design procedures for ventral wall-attachment devices.

The limitations of the theory are usually made clear but some added critical commentary ought to accompany the theory of vortex amplifiers. It is now known, contrary to early assumptions, that reduction in the vortex chamber height can greatly improve turndown performance. No existing theory takes account of this. It is surprising not to see any reference to Chow's results for vortex amplifiers (IFAC Symposium, London 1968) or to Zobel's data for optimized vortex diodes. Evidently, where vortex flows are concerned, the hardware is well in advance of the theory.

The evolution of fluidics is continuing and this book will help its progress but the theory should not be solemnized. The chapter on transmission lines is a major work which will certainly be of great value and not only to fluidics specialists.

J. R. Tippetts