Radar Handbook, 3rd Edition

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Skolnik's ***Radar Handbook*** is the most authoritative, broadest, and deepest single volume on radar. The 3rd edition is an expansion and revision of the first two editions, which were published in 1970 and 1990, respectively. Merrill Skolnik has assembled 38 radar experts with many years of radar experience who convey a radar system engineering viewpoint clearly and quantitatively. The authors are almost all from industry or government laboratories, and the two academic authors are really engineers in disguise. This is not a random collection of Skolnik's friends, but rather these are the world's experts in each technical specialty, including Skolnik himself. The emphasis is on real world performance and real hardware that has been tested and works successfully in the real world, and the physics relevant to radar systems, as well as radar system engineering cost tradeoffs. There are no fuzzy logics or neural nets or wavelets or inscrutable and/or useless mathematical theorems here, but rather there are thousands of useful plots, helpful block diagrams, simple back-of-the-envelope formulas, good rules of thumb, and engineering wisdom that explains when a given plot or formula is a good approximation and when it is not. *What a book!*

Extensive revision of many chapters has brought this into the 21st Century. For example: The chapter on HF over the horizon (GTH) radar has been thoroughly updated to reflect the real-world experience gained in the last two decades from US and Australian radars. Chapter 11 is a superb survey of the state-of-the-art in solid-state transmitters, which have matured substantially since 1990, owing to higher RF power levels and better efficiency made cost-effective by dramatic advances in semiconductor technology; there are many successful real world radars using solid-state transmitters. Some of the latest advances in stealth for US military aircraft and ships have been added to the chapter on radar cross-section (RCS).

There are six completely new chapters in the 3rd edition, on the following topics: ground penetrating radar; remote sensing with radar on satellites; multifunctional radar systems for fighter aircraft (MFAR); digital signal processing for radar; civil marine radar; and propagation. The number of references in each chapter varies widely, from 10 to 197, with a median of 71. The references selected by these experts are vastly superior to a Google search, which would drown the reader in tens of thousands of academic papers without the real world engineering imprimatur of these radar experts. Unfortunately, only three chapters have lists of acronyms and abbreviations, but Google readily solves this problem. The book is printed in black and white on old-fashioned paper, and thus, it is not electronically searchable. The index is 18 pages printed in double columns, but it is somewhat non-uniform in coverage; for example, it lists the alpha-beta filter but not MHT, although both are explained in chapter 7. There are exactly no typographical errors in all 1328 pages; a triumph of editing and spell-checking.

There are, however, a few topics that will, no doubt, be added for the eagerly awaited 4th edition twenty years hence. In particular, there is no mention of MIMO (multiple input multiple output) radar, which is the radar counterpart of MIMO communication systems, and is touted to be much better in almost any imaginable way than boring old phased array radar. All 26 chapters of Skolnik's ***Handbook*** will have to be thoroughly revised to account for MIMO radar. Actually, some hard-boiled radar system engineers think that MIMO radar might be good for HF OTH radar applications, but otherwise, it is mostly academic snake oil.

Furthermore, in the excellent chapter on phased array radars, there is no mention of many of the long range radars designed to detect and track satellites and ballistic missiles. These radars include: AN/FPS-85, PAR-SAFEGUARD, MSR, Cobra Dane, Cobra Judy, PAVE PAWS, BMEWS SSPAR, GBR-P, European midcourse radar (EMR), upgraded early warning radars (UEWR), and the new UHF solid-state phased array early warning radar for Taiwan (SRP). This lacuna is particularly irksome, because many of these omitted radars exceed the other radars as measured by weight, volume, transmit power, antenna gain, power-aperture product, time-bandwidth product, bandwidth, cost, number of lines of real-time code, as well as the size of the surveillance and tracking volume. Also, most of these omitted radars are very high-tech modern solid-state phased arrays, with extremely high reliability and availability in the real world compared with radars that use old-fashioned tube transmitters. Most of these omitted solid-state phased array radars operate essentially 24 hours per day, 365 days per year, for decades.

Moreover, the 3rd edition gives no clue that complex real-time software consisting of millions of lines of code is required to operate many of these multi-function long-range phased array radars, Figure 1.1 in Skolnik's ***Handbook*** would lead the casual reader to suppose that human operators are required to absorb radar data from Ascopes and control the radar system with joy sticks and track balls, whereas, in fact, many of these modern radars are fully automatic, with minimal human intervention. Boredom is a common malady of the human operators at many of these modern radars. One yearns for the 4th edition, which will surely devote a few chapters to automatic adaptive real-time multi-function radar waveform scheduling, automatic target recognition, and multiple hypothesis tracking. These topics are mentioned in the chapters on MFAR, ECCM, and automatic detection, as well as in Skolnik's *Preface* and *Chapter 1*, but 10 dB more quantitative detail is needed.

— Fred Daum