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This Week's Citation Classic

Turin G L. An introduction to matched filters. *IRE Trans. Inform. Theory* **IT-6**:311-29, 1960.
[Hughes Research Laboratories, Malibu, CA]

In a tutorial exposition, the following topics were discussed: definition of a matched filter, where matched filters arise, matched-filter synthesis and signal specification, and some forms of matched filters. [The *SCI*® indicates that this paper has been cited in over 100 publications since 1961.]

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"I was fortunate enough to be a student at the Massachusetts Institute of Technology during the 'golden years' of communication theory there—the late-1940s and early-1950s. From such masters as Bill Davenport, Bob Fano, and Yuk-Wing Lee, I learned to view the communication process as a game of chance: information consisted not of what one certainly knew but what one probably did not know; getting it from place to place was a matter of beating the odds; the odds-maker was 'noise.'

"When I received my MS in 1952, Davenport invited me to join his 'Group 34' at the newly formed MIT Lincoln Laboratory. I jumped at the chance. What a group in which to cut one's teeth! Davenport and Root, Green and Price, and many others were seeking to implement the new communication theory. The systems we designed were odd ones, in which noise was the carrier signal and tens of kilohertz were consumed in sending teletype messages. In the Cold War atmosphere of the day (work at Lincoln was almost all classified), we measured our success in terms of how indistinguishable from noise our signals were.

"A unifying theme in much of what we did in Group 34 was the matched filter, which ubiquitously appeared in the theory. When driven by the signal to which it was matched, such a filter would output a sharp pulse, while virtually ignoring all other inputs such as noise. Matched filters also provided the basis for anti-multipath techniques.

"We tried mightily to employ the primitive electronics of the day to realize matched filters with time-bandwidth with products of a hundred or so. We were not terribly successful. (Only the surface-acoustic-wave and digital technologies of 20 years later would satisfactorily solve the problems we encountered.) Other groups elsewhere were tackling the same problem, but security classifications impeded the free flow of information among them. A good survey of this early work has been given recently by Scholtz.[1]

"I got my doctorate in 1956 and went to Hughes Aircraft Company. Finding that little was known there about matched filters and related topics, I wrote a two-volume internal report on them (volume II was classified).[2] Some time later, Green—still at Lincoln—was asked to edit a special journal issue on matched filters; he invited me to write the introductory article along the lines of my Hughes report. By then, much of the material was declassified, and I was able to incorporate part of volume II in the paper.

"Little of what I wrote about was original with me. The large number of citations the article received is no doubt because I was able for the first time to put the work of many into a survey in the open literature."

1. **Scholtz R A.** The origins of spread-spectrum communications. *IEEE Trans. Commun.* **COM-30**:822-54, 1982.
2. **Turin G L.** *A review of correlation, matched-filter, and signal-coding techniques, with emphasis on radar applications.* Culver City, CA: Hughes Aircraft Co., Systems Development Laboratory, April 1957, Technical Memo 559.