_Designing The Phase Locked Loop FM Stereo Demodulator

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Abstract

During the second and third Summer of my graduate EE studies I worked in the small research department of Warwick Electronics in Niles, Illinois, then one of the largest manufacturers of consumer electronics in the world. My supervisor, William Padgett, was interested in applications of the Phase Locked Loop (PLL) in FM radio design and asked me to investigate applying a PLL to the recovery of the stereo subcarrier in a FM stereo demodulator. This work resulted in a published paper, a patented design and shortly thereafter the first PLL-based FM Stereo Demodulator integrated circuit which has been **used in almost every FM stereo radio produced since 1971.**

This presentation describes the FM stereo composite audio signal, historically how it is generated and demodulated, the problems encountered using a PLL to synchronize the 38 kHz subcarrier, the underlying mechanisms causing the problems and their solutions. **This shows that it is possible that an engineering student can do important work while an intern.**

Speaker's Biography

Jeffrey N. Denenberg has more than 30 years of experience in the electronics, communications, and computer industries. He has also been active in engineering education, teaching graduate and undergraduate engineering and computer science courses at several schools and here at Fairfield University for more than 25 years.

He received his BS from Northwestern University in 1966 and both an MS and Ph.D. from the Illinois Institute of Technology in 1968 and 1970 respectively, all in Electrical Engineering. Dr. Denenberg holds 20 patents covering a wide variety of technical areas. Most of his inventions have been used in commercial products.

Dr. Denenberg has published many technical papers and has been a contributing author for two books. He is a Senior Life Member of the IEEE, has been awarded the ITT Corporation "Inventor of the year", is a BEI Fellow of the School of Engineering at Fairfield University and was awarded the Alumni Metal in 2022 by the Illinois Institute of Technology.