Tutorial T6A

Pedagogy of Negative Feedback Circuits

Nagendra Krishnapura, Indian Institute of Technology Madras, India

Abstract

This tutorial presents an introduction to negative feedback circuits using an integrator as the central element instead of a high gain amplifier as is normally done. It is shown that it is easier to make a connections to our intuitive notion of negative feedback in the time domain than in the frequency domain. It is also shown that certain aspects of negative feedback systems that they have a nonzero time constant (finite bandwidth), that delay can lead to instability, and that negative feedback systems can be stabilized by slowing them down become immediately clear with this approach. It is also shown that the opamp and the phase locked loop can be synthesized from the prototype negative feedback system using an integrator to continuously drive the output until the error between the desired and actual outputs becomes zero. Realizing such a negative feedback amplifier using real components and striving to improve its performance leads to different opamp topologies. Attempting to realize a frequency multiplier and improving its performance leads to type I and type II feedback loops. The synthesis based approach from a common foundation helps one to easily make connections between different negative feedback circuits.

Speaker Biography

Nagendra Krishnapura is an Associate Professor of Electrical Engineering at the Indian Institute of Technology, Madras in Chennai. He obtained the B.Tech degree in Electronics and Communication Engg from the Indian Institute of Technology, Madras in 1996 and the masters and doctoral degrees from Columbia University, New York in 1998 and 2000 respectively. Between 2000 and 2005, he worked as a senior design engineer at Celight, Inc. and Multilink (later Vitesse Semiconductor) where he designed integrated circuits for high speed broadband communications. Since June 2005, he has been with the Department of Electrical Engineering of the Indian Institute of Technology Madras, where he teaches, conducts research and consults for several companies in the areas of high speed analog circuit design and signal processing.