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STABILITY ANALYSIS OF ALMOST SINUSOIDAL PERIODIC OSCILLATIONS IN NONLINEAR CONTROL SYSTEMS SUBJECTED TO NONCONSTANT PERIODIC INPUT

G.S. KRENZ AND R.K. MILLER

ABSTRACT. We investigate the existence, local uniqueness and local stability properties of almost sinusoidal periodic oscillations in a class of nonlinear control systems subjected to a nonconstant periodic input.

Provided two parameters are sufficiently small, a modified Routh-Hurwitz condition is given which determines the stability of the forced response. The analysis uses (1) the classical single-input sinusoidal describing function to predict the amplitude and phase shift of the fundamental component of the forced response; (2) a novel linearization of the forced problem; (3) averaging; and (4) a simple theorem concerning perturbed linear systems.

We present several systems which, in theory, satisfy our results. A specific example demonstrates how the results could be used in practice.

1. Introduction. John Nohel wrote his thesis in 1953 at MIT under the guidance of Norman Levinson. The topic of this thesis was stability of periodic solutions of perturbed periodic and autonomous differential equations. This thesis complemented 1952 results of Coddington and Levinson. A portion of the thesis was published in 1960, cf. [**23**]. Richard Miller wrote his thesis [**18**] in 1964 under the guidance of John Nohel on the subject of stability of solutions of perturbed periodic differential equations. Gary Krenz wrote his thesis [**13**] in 1984 under the guidance of Richard Miller. Continuing the tradition, he wrote on the subject of stability of periodic solutions of nonlinear differential equations. This paper contains a portion of the results from Krenz's thesis.

The results of Nohel in [**23**] are proved using Floquet multipliers and some delicate analysis of matrix functions and their determinants. The results in [**18**] were proved using invariance principle arguments which complemented and generalized earlier work of John and J.J. Levin. The results in the present work depend on an integral manifold result,