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ENERGY DECAY ESTIMATE FOR A POWER SYSTEM MODEL WITH NONLINEAR FEEDBACK

A. Y. Khapalov[1] and P. Nag[2]

[1]Department of Mathematics
Washington State University, Pullman, WA 99164-3113, USA
e-mail:khapala@math.wsu.edu
[2]Department of Mathematics
Black Hills State University, Spearfish, SD 57799-9127, USA
e-mail:pnag@bhsu.edu

Abstract. In this paper we consider a model of a power system which consists of a single electric generator connected to an infinite bus by a transmission line. This model is widely used to study the effect of various controllers on power system stability. In this paper we introduce a smooth nonlinear stabilizing feedback, motivated by so called FACTS devices, which changes the admittance of the transmission line. Our goal is to derive an explicit energy decay estimate for solutions of the corresponding system of ordinary differential equations.
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1 Introduction

1.1 Motivation. We consider the following model of a single electric generator and an infinite bus connected by a transmission line:

$$M\frac{d^2\delta(t)}{dt^2} \;=\; P_m \;-\; B(t)\sin(\delta(t)), \qquad (P)$$

where M and P_m are respectively the moment of inertia and mechanical power input, while $B(t)$ and $\delta(t)$ are the line admittance and the load angle at time t.

In recent years, a new generation of devices called Controllable Series Devices, i.e., series connected Flexible AC Transmission Systems (FACTS devices) such as, e.g., the Unified Power Flow Controller (UPFC) and Controllable Series Capacitor (CSC), have been developed to control both the real and reactive power flows through transmission lines, thus improving transient stability and damping electromechanical oscillations (for more details see, e.g., [2], [11], [6]). All these devices employ the principle of changing the transmission line admittance, which modulates the real power flow through