DECENTRALIZED SEMI-ACTIVE SEISMICCONTROL USING FUZZY CONTROLLER

Amin KAVEI DEYLAMI
MSc Student, School of Civil Engineering, University of Tehran,P.O. Box 11155-4563, Tehran, Iran
amin_kavee@ut.ac.ir

Amir K.GHORBANI-TANHA,
Assistant Professor, School of Civil Engineering, University of Tehran, aP.O. Box 11155-4563, Tehran, Iran
ghtanha@ut.ac.ir

Keywords: Decentralized Control, Semi-active Control, Fuzzy Control, Tall Buildings, Seismic Control

ABSTRACT

There are many different methods to find required control forces or damping values to decrease structural responses due to seismic excitations by a one centralized controller. In tall buildings there are some additional problems like time delay and controller unreliability, because of the higher number of sensors, actuators or dampers. In this paper, a decentralized semi-active control algorithmis proposed. In decentralized control,the structural system is decomposed into several substructures. Different controllers are available each one dealing with one substructure to obtain control properties using a certain that may be different to other subsystems control forces or natural characteristics modifications are applied just to the respective substructure. In present study, based on local substructure information, fuzzy controller calculates damping values for its subsystem.Each controller receives displacement and acceleration values of its floor as feedbacks and controls them. Controlling these values automatically results in decreasing of story drift and other useful values. The effectiveness of decentralized semi-active control algorithms is demonstrated through numerical examples. A model of building subjected to seismic excitations is developed and the dynamic responses are obtained in both uncontrolled and controlled cases by employing proposed decentralized control method. Moreover, the results for controlled case are compared to those obtained by using available decentralized methods to show the efficacy of the proposed algorithm.

INTRODUCTION

Control of building structures using different algorithms and various control mechanismsagainst earthquake or wind loading has gained much attention in the past few decades. However, the reliability of these kinds of control systems are a main concern. If for any reason the central controlunit loses its functionality during an earthquake, the operation of the whole control system will be disrupted.In that regard, the decentralized control approach has been considered by researchers as a substitute in recent years. In this approach, the main structural system is divided into a number of simpler subsystems, each one being controlled independently. Furthermore, this method can reduce the total length of transmission of data between sensors, control center and actuators. This kind of decentralized control approach, where possible, would lead to more reliable control systems(Rofooeiand Monajemi-nazhad, 2007).

In recent years, due to their reliability and adaptability, considerable attention has been directed to research and development of semi-active control devices. One such innovative device is the magnetorheological (MR) damper, which employs MR fluids to provide control capability. An MR damper offers a highly reliable mechanism for response reduction at a modest cost, and is fail-safe because the damper becomes passive if the control hardware malfunction.From this point of view, structural vibration control using MR dampers is one of the most promising fields in civil engineering, and a wide range of theoretical and experimental studies have been performed to assess the efficacy of MR dampers (Dyke et al, 1996).