

CHAOS: ITS CONTROL AND GENERATION FOR ENGINEERING APPLICATIONS ¹

Guanrong Chen

Department of Electronic Engineering,
City University of Hong Kong
Kowloon, Hong Kong SAR, P. R. China

Abstract. Chaos is a special complex dynamical phenomenon, which has been studied for near four decades. Only recently has the objective of this research endeavor evolved to the stage of controlling and utilizing chaos toward engineering and technological applications. In a broader sense, chaos control refers not only to weakening or completely suppressing chaos when it is harmful, but also to generating or modifying existing chaos when it is useful. Research in the emerging field of chaos control has become intensive today. This article offers a brief overview of the potential impact of chaos control on beneficial applications in natural science and engineering.

Keywords. Chaos, chaos control, chaos generation.

AMS (MOS) subject classification: 28A65, 34D, 58F20

1 INTRODUCTION

Chaos refers to one type of complex dynamical behaviors that possess some very special features, including typically its extreme sensitivity to tiny variations of initial conditions as well as system parameters, its orbital confinement within a bounded region in the phase space yet possessing a positive leading Lyapunov exponent that preventing convergence, its finite Kolmogorov-Sinai entropy, continuous-like power spectrum, and fractional topological dimension, etc. More often than not, chaos coexists with some other complex dynamical phenomena such as bifurcations and fractals ([1,2]).

Ever since Lorenz ([3]) and Li-Yorke ([4]), chaos as a main subject of theoretical research has been continuously investigated in many fields of natural sciences, mathematics and engineering. Although chaos is a very attractive subject for study, due to its intrinsic topological complexity it was once believed to be neither controllable nor predictable. Consequently, chaos was considered to be a charming notion for science but useless entity for engineering and technology. This misunderstanding was an obstacle to many engineers earlier, and yet lately it became a challenge that greatly motives control theorists and engineers to explore the possibility of tackling chaos toward practical applications.

¹Supported by Hong Kong CERG Grants 9040565 and 9040579, and the Hong Kong CityU SRG Grants 7001174 and 7001328.