Electromechanical Dynamics

Chapter 3

LUMPED-PARAMETER ELECTROMECHANICS

3.0 INTRODUCTION

Having reviewed the derivations of lumped electric circuit elements and rigid-body mechanical elements and generalized these concepts to allow inclusion of electromechanical coupling, we are now prepared to study some of the consequences of this coupling.

In the analysis of lumped-parameter electromechanical systems experience has shown that sufficient accuracy is obtained in most cases by making a lossless model of the coupling system. Thus energy methods are used to provide simple and expeditious techniques for studying the coupling process.

After introducing the method of calculating the energy stored in an electromechanical coupling field, we present energy methods for obtaining forces of electric origin. We shall then study the energy conversion process in coupling systems and finally discuss the formalism of writing equations of motion for complete electromechanical systems. The techniques for analyzing the dynamic behavior of lumped-parameter electromechanical systems are introduced and illustrated in Chapter 5.

3.1 ELECTROMECHANICAL COUPLING

There are four technically important forces of electric origin.

1. The force resulting from an electric field acting on free charge.
2. The force resulting from an electric field acting on polarizable material.
3. The force resulting from a magnetic field acting on a moving free charge (a current).
4. The force resulting from a magnetic field acting on magnetizable material.