
Contents

Preface	ix
Table of Notations	xi
Chapter 1. Set of Solids with Neither Loops Nor Branches.	1
1.1. Identifying a chain of solids with neither loops nor branches .. .	1
1.2. Applying the fundamental principles of mechanics .. .	2
1.2.1. Principle of effort generators.	3
1.2.2. Principle of effort receivers .. .	4
1.2.3. Applying the fundamental principle of dynamics.	4
1.2.4. Theorem of mutual actions .. .	7
1.2.5. Summary of equations obtained .. .	8
1.3. Study of the movement of a chain of solids (case of three solids).....	8
1.3.1. Applying the fundamental principle of dynamics.	8
1.3.2. Solidifying parameters .. .	9
1.3.3. Movement equations .. .	11
1.3.4. Determining the link unknowns .. .	18
1.4. Links between solids .. .	18
1.4.1. Link associated with the point contact of two solids .. .	18
1.4.2. Link torsor associated with the line contact of two solids ..	25
1.4.3. Link torsor associated with the surface contact of two solids .. .	28
1.4.4. Fundamental links between two solids in contact .. .	32

Chapter 2. Vibration Mechanics of Systems of Solids	35
2.1. Movement equations of a set of solids	35
2.1.1. Configuring and situating a set of solids in a Galilean frame	35
2.1.2. Velocity distributors of n solids	37
2.1.3. Torsors associated with loads and efforts	38
2.1.4. General equation of dynamics derived from the fundamental principle.	39
2.1.5. Applying analytical mechanics of movement	39
2.2. Linear oscillatory systems with n solids	42
2.2.1. Setting the problem as an equation.	42
2.2.2. Equilibrium of a set of n solids	46
2.2.3. Oscillations of a set of n solids	47
2.2.4. Vibration eigen modes of a set of n solids	48
2.2.5. Influence of the initial conditions of the problem	53
2.3. Studying the vibrations of a continuous set by passing to the limit	54
2.3.1. Taking the boundary conditions into account at any instant.	59
2.4. Exercises	62
2.4.1. Exercise 1: movement equations – equilibrium	62
2.4.2. Exercise 2: movement around an equilibrium position	75
2.4.3. Exercise 3: dynamics of an RTT robot (one rotation + two translations)	85
Chapter 3. Vibrations with N Degrees of Freedom	97
3.1. Introduction	97
3.2. Homogeneous system – free vibrations ($f_1 = f_2 = 0$)	99
3.2.1. Without damping ($c_{ij} = 0$)	99
3.2.2. Solving the system (Σ)	100
3.2.3. Damped free system	108
3.3. Response on the time domain of an excited system	112
3.4. Exercises	113
3.4.1. Exercise 1: eigen modes of a system with 2 DOF	113
3.4.2. Exercise 2: free and forced oscillations of a conservative 2-DOF system	118
3.4.3. Exercise 3: calculation/test correlation	125
3.4.4. Exercise 4: damped system with a single excited mode	128
3.4.5. Exercise 5: system excited by the base	137

Chapter 4. Modal Analysis of <i>N</i> Degrees of Freedom	145
4.1. Introduction	145
4.1.1. Normal modes	145
4.2. Response in the frequency domain of a conservative structure subjected to a harmonic excitation.	146
4.3. Response of a structure with proportional viscous damping to a harmonic excitation	150
4.4. Frequency response of a structure with proportional hysteretic damping	153
4.5. Exercises	155
4.5.1. Exercise 1: receptance matrix of a conservative structure . .	155
4.5.2. Exercise 2: receptance matrix of a structure with proportional viscous damping	164
4.5.3. Exercise 3: case of a non-diagonal mass matrix	170
References	177
Index	179