

Theory and Applications Lecture Notes in Mathematics 2250: A Comprehensive Resource

MATH 2250-4 PROJECT 3: EARTHQUAKES November, 2001

Your final project for Math 2250 this semester is the Earthquake project on pages 437-438 of Edwards-Penney. The template for this project is at our home page <http://www.math.utah.edu/~korevaar/2250fall01.html>. In these notes we will work through the book examples from section 7.4, using illustrative Maple commands.

Let's start with example 1 on page 427 of Edwards-Penney. Initially it is an unforced system with two masses and two springs, as you can see from the description on page 427. We can write the system as $M\mathbf{x}'' = \mathbf{K}\mathbf{x}$, where M is the "mass matrix", K is the "spring matrix", and \mathbf{x} is the displacement vector. Following the book's notation, we enter

```
[ > with(linalg):with(plots):with(DEtools): #tools
> M:=matrix([[2,0],[0,1]]);
K:=matrix([[-150,50],[50,-50]]);
A:=evalm(inverse(M)&*K);
```

$$M := \begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$$

$$K := \begin{bmatrix} -150 & 50 \\ 50 & -50 \end{bmatrix}$$

$$A := \begin{bmatrix} -75 & 25 \\ 50 & -50 \end{bmatrix}$$

Then the system can also be written as $\mathbf{x}'' = A\mathbf{x}$, and the eigenvectors of A determine fundamental modes, and the corresponding negative eigenvalues are the (opposites) of the squares of the corresponding angular frequencies:

```
[ > eigenvects(A);
[-100, 1, [[1, -1]], [-25, 1, [[1, 2]]]
```

Therefore, the natural frequencies of this system are the 10 and 5, and the two fundamental modes correspond to the masses moving in opposite directions (with equal amplitudes and angular frequency 10) and in parallel directions (with amplitude ratio of two and angular frequency 5).

Now, let's consider the forced system with force vector equal to $\cos(\omega t)[0, 50]$, i.e. the second mass is being forced periodically. In other words, the system $M\mathbf{x}'' = \mathbf{K}\mathbf{x} + \mathbf{F}$, where $\mathbf{F} = \cos(\omega t)[0, 50]$ discussed on page 433. We follow the method described on that page to find a particular solution to the forced oscillation problem, of the form given by equation (31). The details of this computation are explained in example 3 of the text, and here is the Maple version:

```
[ > F0:=evalm(inverse(M)&*vector([0,50]));
#The F0 in the normalized equation (30), page 433
Iden:=array(1..2,1..2,identity);
#the 2 by 2 identity matrix
Aleft:=omega->evalm(A + omega^2*Iden);
#the matrix function on the left side of (32)
c:=omega->evalm(-inverse(Aleft(omega))&*F0);
```

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Multilinear Operator Integrals: Theory and Applications (Lecture Notes in Mathematics Book 2250)

by Toshiaki Yoshida(1st ed. 2019 Edition, Kindle Edition)

★★★★☆ 4 out of 5

Language : English

File size : 3518 KB

Screen Reader : Supported

Print length : 203 pages



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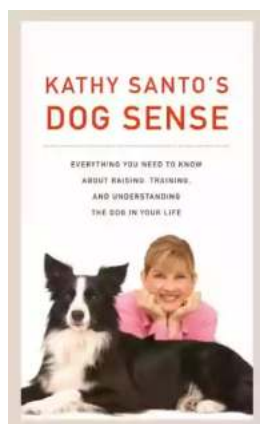
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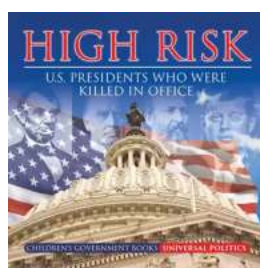
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