LECTURE 3 6-25-09

YESTERDAY: $x \rightarrow \hat{x}\, e^{i\omega t}$

- TAKE DERIVATIVES

ALGEBRAIC EQN

FREE OSCILLATOR ⇒ SOLVE FOR ω

DRIVEN OSCILLATOR ⇒ SOLVE FOR $\hat{x}$

$\hat{x} \rightarrow r\, e^{i\varphi}$

(r: amplitude; φ: phase)

READING 2

THE SAME EQUATIONS HAVE THE SAME SOLUTIONS.

FEYNMAN → D EQUATIONS

YOU UNDERSTAND THE EQUATIONS WHEN YOU KNOW THE ANSWER BEFORE YOU SOLVE THEM.

ANALOGOUS OSCILLATORS

WIKI HARMONIC_OSCILLATOR

The simple damped harmonic oscillator:

http://en.wikipedia.org/wiki/Damping

The damped driven harmonic oscillator:

http://www.physics.purdue.edu/class/applets/phe/resonance.htm

http://qbx6.ltu.edu/s_schneider/physlets/main/osc_damped_driven.shtml

The normal modes for 2 coupled oscillators:

http://www.maths.surrey.ac.uk/explore/michaelspages/Coupled.htm

http://www.physics.purdue.edu/class/applets/phe/cpendula.htm

http://www.falstad.com/coupled/

http://mcs.open.ac.uk/rh8/Modes.html

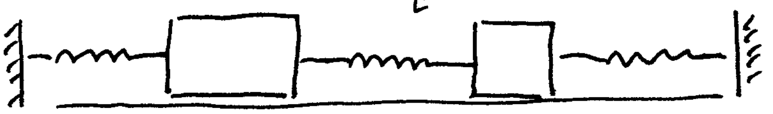
http://www.falstad.com/membrane/

http://www.falstad.com/membrane/j2/

http://www.falstad.com/circosc/

http://www.falstad.com/barwaves/

add spring ; ~~add~~ turn on coupling ; pair of coupled oscillators



$\omega_1 = \frac{k_1}{m_1}$ $\qquad$ $\omega_2 = \frac{k_2}{m_2}$

OSCILLATOR 1 $\quad$ 1 DOF

" $\quad$ 2 $\quad$ 1 DOF

COUPLED OSCILLATOR $\quad$ 2 DOF

1d $\quad$ N OSC $\quad$ N DOF

2d $\quad$ N OSC $\quad$ 2N DOF

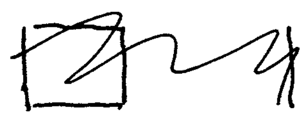
3d $\quad$ " $\quad$ " $\quad$ 3N DOF

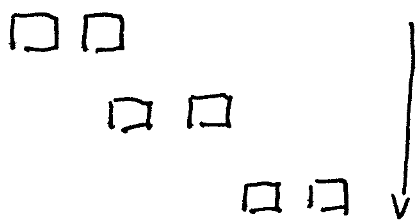
WANT TO FIND THE NORMAL MODES

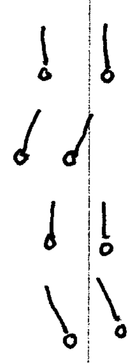
THE CHARACTERISTIC FREQUENCIES OF MOTION

PATTERNS OF MOTION

SYMMETRIC MOVE TOGETHER



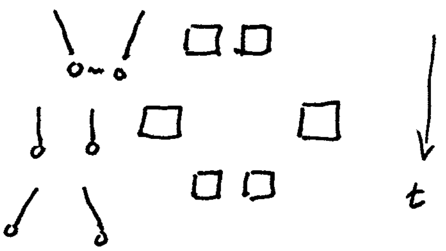




$\omega_s = ?$

$\omega_s = \omega_0 !$

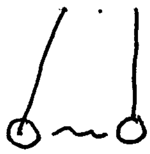
ANTISYMMETRIC : MOVE OPPOSITE



$\omega_a = ?$

$\omega_a > \omega_0$

WHAT HAPPENS IF MOVE ONLY ONE OF THE MASSES?



SHOW DEMO

EOM

$F_1 = m_1 a_1 = m a_1$ $\qquad\qquad$ $k_1 = k_2$

$F_2 = m_2 a_2 = m a_1$

without coupling

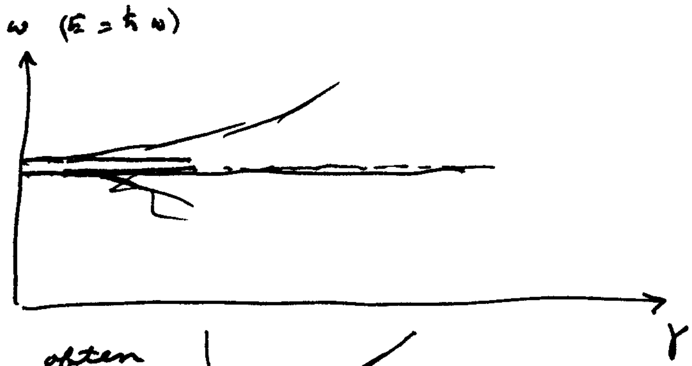
$$\omega_1 = \sqrt{\frac{k}{m}} = \omega_0$$

$$\omega_2 = \sqrt{\frac{k}{m}} = \omega_0$$

AFTER

$\omega_1' = \omega_0$

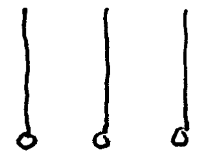
$\omega_2' > \omega_0$



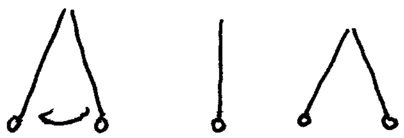
often

3 OSCILLATORS

- N MODES 3 MODES

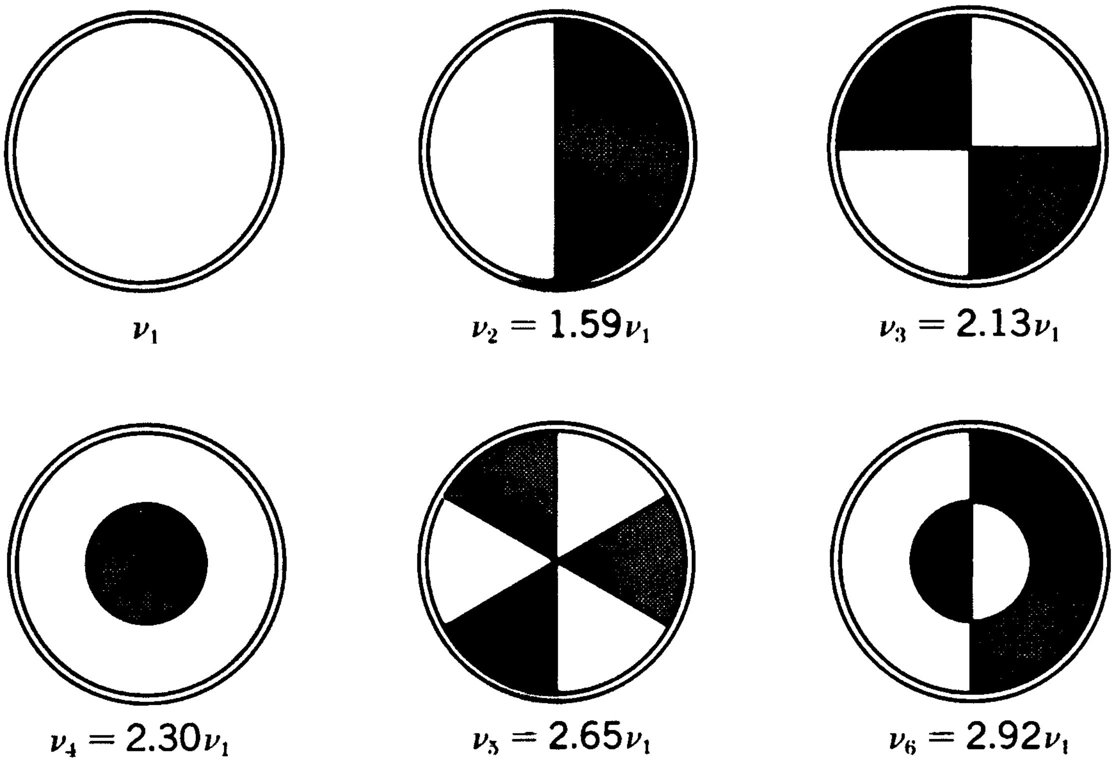


SYMMETRIC



ANTISYMMETRIC
WRT CENTER

FALSTAD


ν_1
$\nu_2 = 1.59\nu_1$
$\nu_3 = 2.13\nu_1$
$\nu_4 = 2.30\nu_1$
$\nu_5 = 2.65\nu_1$
$\nu_6 = 2.92\nu_1$