Week 16: Mechanical design, Machine design

20.5. 2015

This week we will learn about mechanical design.

The agenda:
http://academy.cba.mit.edu/classes/mechanical_design/index.html

vendors McMaster-Carr Stock Drive Products Amazon principles stress-strain moduli elastic, plastic flow friction spalling hysteresis backlash flexure force loops elastic averaging kinematic coupling materials plastic metal ceramic rubber foam adhesives fasteners nuts bolts washers framing metal plastic t-slot self-aligning drive gears sprockets belts chains shafts rods nuts guide shafts rails slides couplers shafts joints bearings ball thrust linear rotary sleeve rotary wheels pulleys casters lubricants cables ties carriers wire fiber liquids pipe tubing conveyors springs mechanisms flexures linkages whippletree pantograph Sarrus CoreXY Hoberman

Group assignment: to make a machine, including the end effector. Build the passive parts and operate it manually. Document the group project and your individual contribution.

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mtm.cba.mit.edu/machines/science/

Basics for mechanical design

Nadia: machine building

Stress versus strain ...

Avoid friction
Removing hysteresis and backlash
Use flextures

Force loop – keep that as small as possible

Kinetic coupling

Materials – McMster's

Avoid adhesives, so that the designs are reversible

Nuts – anticipate that the nuts will move.  Minimize

Machines that make:  http://mtm.cba.mit.edu/

Framing – use channels, extrusions.  Laser cutting, folding

Transfer force from motor to a what is going to move.  Gears –
different kinds.  Gears design...
Shafts, drives...
Shaft coupling, motor coupling

Bearings let things move...
Ball: http://www.mcmaster.com/#standard-ball-and-roller-
bearings/=x9hzzc
Linear:  http://www.mcmaster.com/#standard-linear-bearings/=x9i0o9

Assembling of machine:
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Flexures:

Synthisis and analysis of Parallel Kinematic XY fleaxure mechanism:
http://academy.cba.mit.edu/classes/computer_cutting/56836505.pdf

Machine Design
http://academy.cba.mit.edu/classes/machine_design/index.html

Plan a machine
Build the passive parts
Work through the operations, work it by hand – discover the issues
Automate the machine – sense what it is doing, actuate it, power it
Open loop – tell the machine what to do
Closed loop –

Modern control theory

Automate the machine – when the parts are build

Nadia:

Personal fabrication: http://www.media.mit.edu/personalfab/

Workflow: laser cutter, water cutter, milling machine,
Fabmodules, toolpathing – export,
Machine instruction, G-code (and M-code)

Control system for the machine itself – design boards for and
execution code
Machines that have a brain that takes coordinates in...
Machine control network
Moving things
Tool force, precision, speed
Machining parameters
Linear Motion Guides

Software framework talking to network nodes

Baseline – not a cap for what we can do
Never halfplug anything, assemble first, then power
Don't turn the motors manually

No hot plug
No backdriving

Rhino model – is parametric, see:
http://mtm.cba.mit.edu/machines/science/
http://schoolofma.org/

Instruction:
http://mtm.cba.mit.edu/machines/science/
http://monograph.io/james/m-mtm

First cut the carboard, then assemble, move things around

Sudo python setup install

Document individually what you make – make a slide of what is
collaborated on

Assignment work:

Direction – simple, fun as group to do
Arthur Ganzo

3 piece with motors – we have this for working
Chessboard example

Blender stick with the Shopbot, but fun to do

Understanding movement

Cardboard skeleton, holds on to the movement
Computer, board and the motor

Following instruction and make it... 2 weeks timelimit

Robot...

Arduino Drawing Machine: https://www.youtube.com/watch?v=gefrytqqBx8

Record player drawing machine: https://vimeo.com/68768487

Ulinecardboard.dxf was opened in Rhino and saved as ai
The file is opened in illustrator
In illustrator the lines are joined.
Red lines are cut
Saved as illustrator default pdf
Delete the blue lines
Paste in place (leaving the canvas as is)
Save as pdf

In Rhino select the model lines – export as pdf
Select oversise, clic view and output scale – 1:1
In Scale – on paper 1.0 and in model 1.0
Position – Upper left

Turn laser cutter on
Pointer
XY off – go
Enables movement of slá
Use horn to set difference of laser to cardboard, á að liggja alveg þétt við
Færa laser í vinstra horn efst - arrows
Set home and reset
Setja lykil í vélina og velja file
Do red line file first – open pdf
Print
Select right or left lasercutter – check actual size, set orientation on portrait. Properties: Force to use, different for materials.

(PDF – Redlines, engraving)

Engraving – vector, speed – 80%, Power – 10%, Frequency – 500 Hz.
Piece size (mm) – set in numbers after measuring for horizontal and vertical.
PRINT – check that the right file is in the job window, put press on (Redlines
Cutting – speed – 30%, Power – 80%, Frequency - 500 Hz
PRINT