



SEM0104 - Aula 1

Introdução e Motivação

Prof. Dr. Marcelo Becker

SEM - EESC - USP

Prof. Dr. Marcelo Becker - SEM - EESC - USP

Sumário da Aula

- **Informações sobre o Curso**
- Introdução
- Histórico
- Exemplos de Aplicação

Informações sobre o Curso

- Aulas 4^{as} (8h – 10h) e 5^{as} (10h – 12h)
- Nota:
$$NF = \frac{P_1 * 3 + P_2 * 4 + \text{Projetos} * 3}{10}$$
- Datas da Provas:
 - P₁: 22/ABR/2015
 - P₂: 17/JUN/2015
 - Competição: 24/JUN/2015
 - Sub.: 01/JUL/2015 (apenas para quem faltou)

Informações sobre o Curso

Ementa do Curso

- As equações gerais de movimento e tipos de mecanismos.
- Mecanismos articulados.
- Métodos gráficos.
- Polígonos de velocidade e aceleração.
- Dinâmica de Mecanismos.
- Cames.
- Engrenagens cilíndricas com dentes com perfil de envolvente.
- Trens de engrenagens.
- Mecanismos planetários.

Informações sobre o Curso

Bibliografia Recomendada

- Shigley, JE. e Uicker, JJ., 1995, "*Theory of Machines and Mechanisms*".
- MABIE, H.H., OCVIRK, F.W. "Mecanismos e dinâmica das máquinas".
- MARTIN, G.H. "Cinematics and dynamics of machines".
- NORTON, R. L. "Design of Machinery - An Introduction to the Synthesis and Analysis of Mechanisms and Machines"
- Notas de Aula

Contato

Prof. Dr. Marcelo Becker

Av. do Trabalhador são-carlense, 400

São Carlos - SP - 13566-590 – Brasil

Prédio da Mecatrônica – 2º andar – sala 29122

Tel: 16 - 3373 8646

e-mail: becker@sc.usp.br

Skype: marcelo.becker

Sumário da Aula

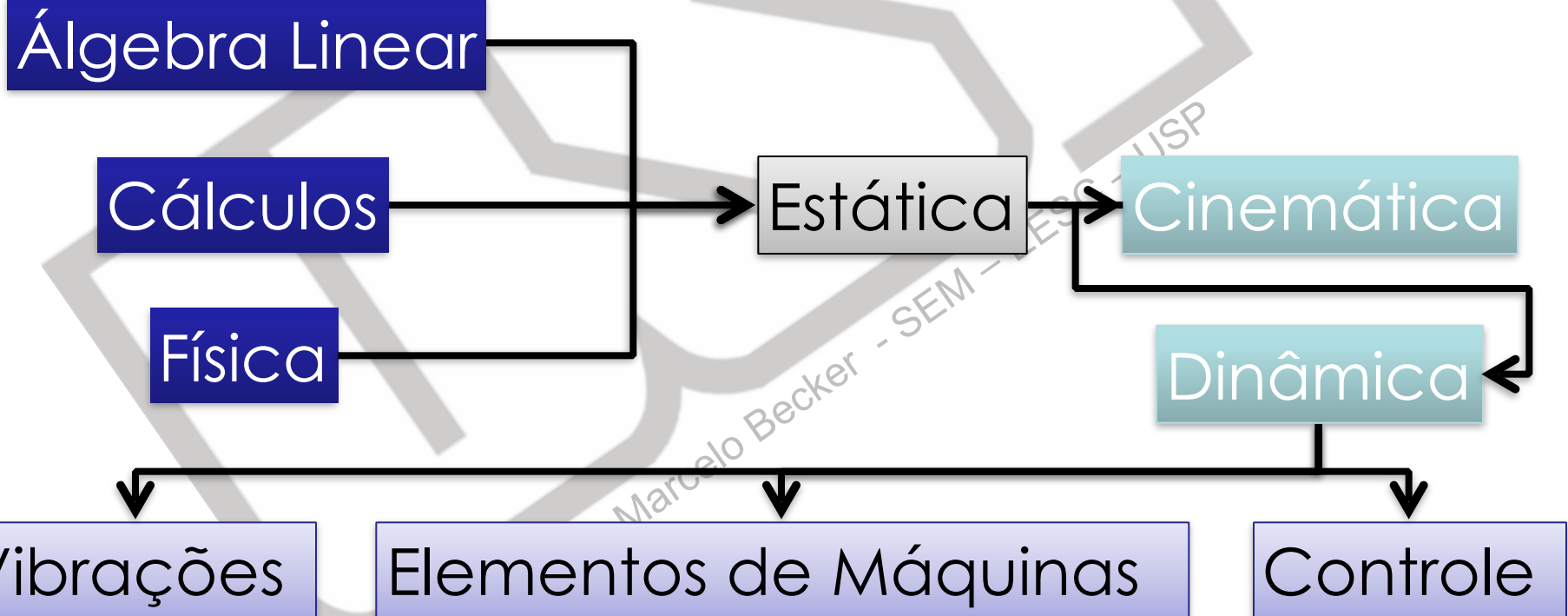
- Informações sobre o Curso

- **Introdução**

- Histórico
- Exemplos de Aplicação

Introdução e Motivação

- Pergunta: O porquê de se estudar mecanismos?



Análise de Mecanismos

The screenshot displays the Roberts Animator software interface. On the left, a table lists the properties of joints and links. The main window shows a 2D plot of a mechanism with joints A, B, C, D, and E, and links AD, AB, BCE, and CD. A graph at the bottom shows the rotation angle Ψ of Link BCE as a function of the input rotation Φ .

Properties	x [mm]	y [mm]
Joint A	-320,000	-250,000
Joint B	-430,000	-160,000
Joint C	-250,000	-50,000
Joint D	200,000	-400,000
Joint E	0,000	0,000

Links	Joints	Length
Link AD	AD	541,000
Link AB	AB	142,000
Link BCE	BC	210,000
Link BCE	BE	458,000
Link BCE	CE	254,000
Link CD	CD	570,000

Graph: Ψ Rotation Link BCE 0,000°

Y-axis: 47,634, -42,907

X-axis: 0,000, 360,000

Input: Φ Input Rotation 0,000°

Síntese de Mecanismos

The screenshot displays the Watt Demo software interface for mechanism synthesis. The main window shows a mechanism diagram with links numbered 1 through 5. A red arrow points to the mechanism diagram, and another red arrow points to the graph below it.

The left sidebar contains a list of mechanisms:

Name	Nr
Stephenson 3	11
Stephenson 3	30
Fourbar	10
Stephenson 3	29
Stephenson 3	12
Stephenson 3	17
Stephenson 3	9
Stephenson 3	49
Stephenson 3	33
Fourbar	8
Stephenson 3	72
Stephenson 3	78
Stephenson 3	43
Stephenson 3	41
Stephenson 3	2
Fourbar	4
Fourbar	7
Fourbar	5
Fourbar	1
Fourbar	2
Fourbar	3

The graph at the bottom shows the Path Error (mm) versus Input Rotation (degrees). The error is 0.000 mm. The input rotation ranges from 0.000 to 120.030 degrees. The graph shows a red curve representing the path error. A red arrow points to the graph, and another red arrow points to the value 7.329 on the y-axis.

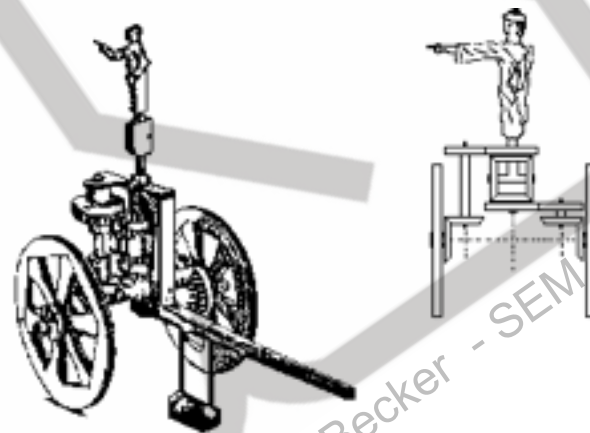
Sumário da Aula

- Informações sobre o Curso
- Introdução
- **Histórico**
- Exemplos de Aplicação

Histórico

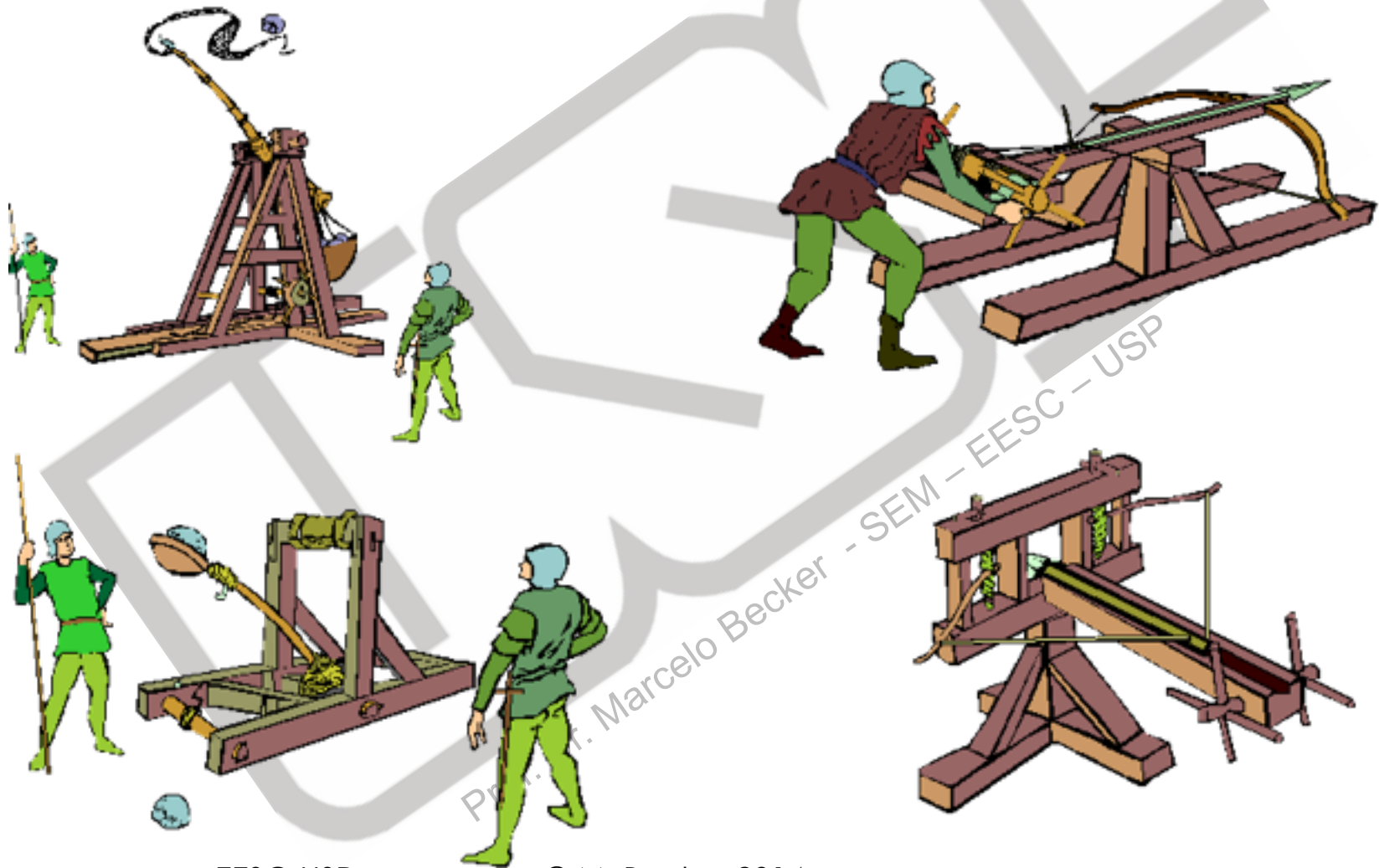
Carroça Chinesa (2.634 a.C.)

Imperador Huang Di (China)



Histórico

Armas

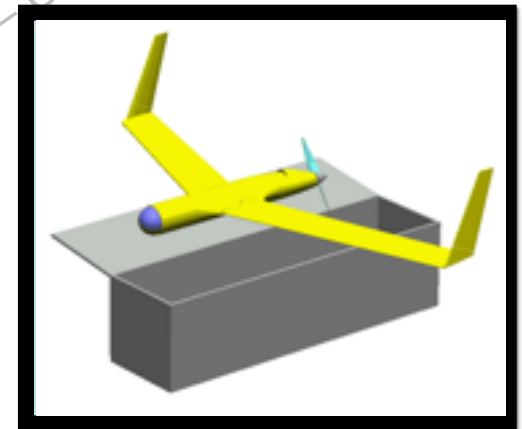


Histórico

Catapultas 'Modernas'

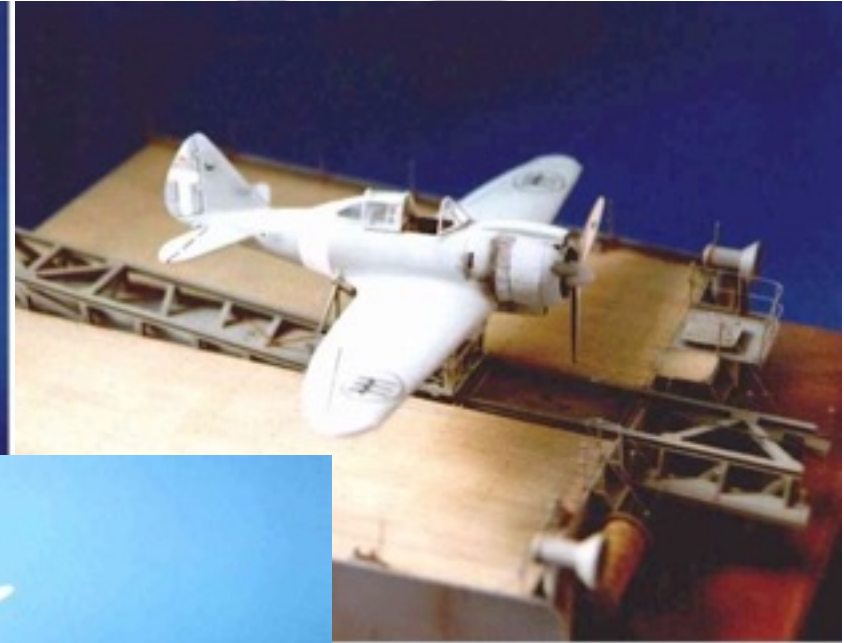
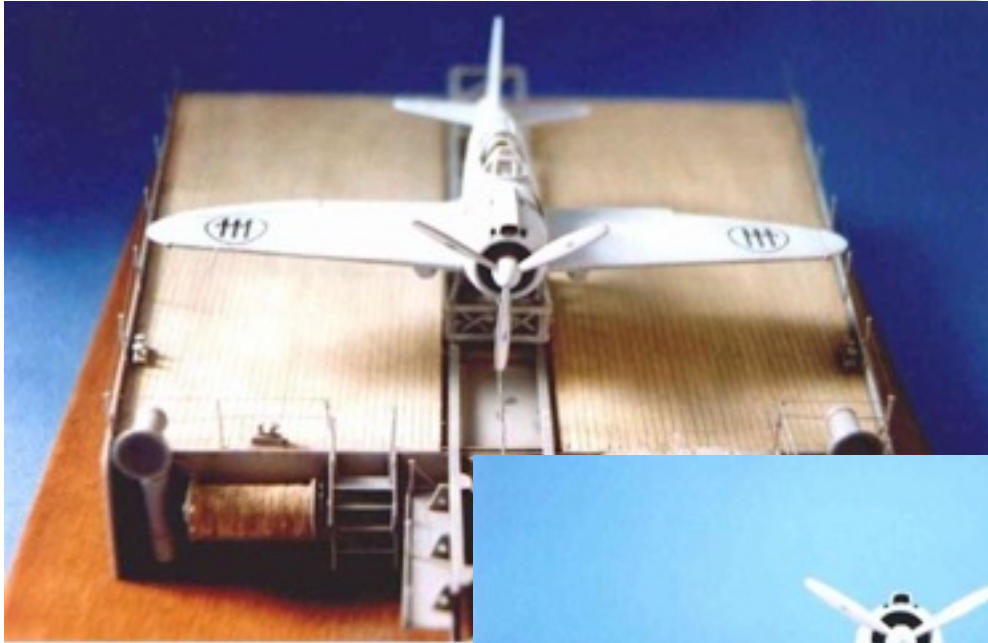
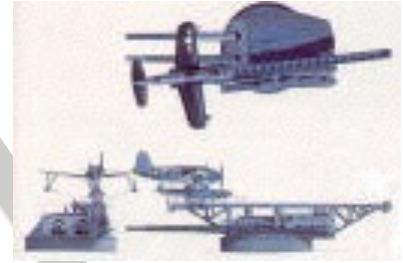


Aeromodelos
e
Planadores



Histórico

Catapultas 'Modernas'



Histórico

Catapultas 'Modernas'



EESC-USP

© M. Becker 2014



Histórico

Catapultas 'Modernas'



Histórico

Armas



Cel. Samuel Colt
(*1814 + 1862)



EESC-USP

Peças
Intercambiáveis

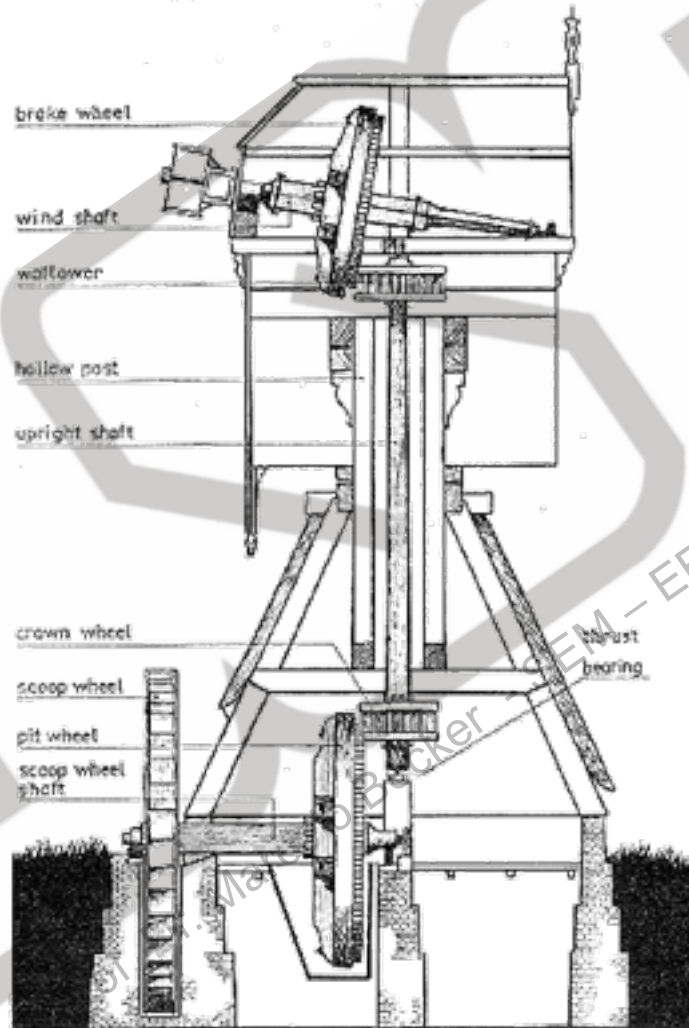


© M. Becker 2014



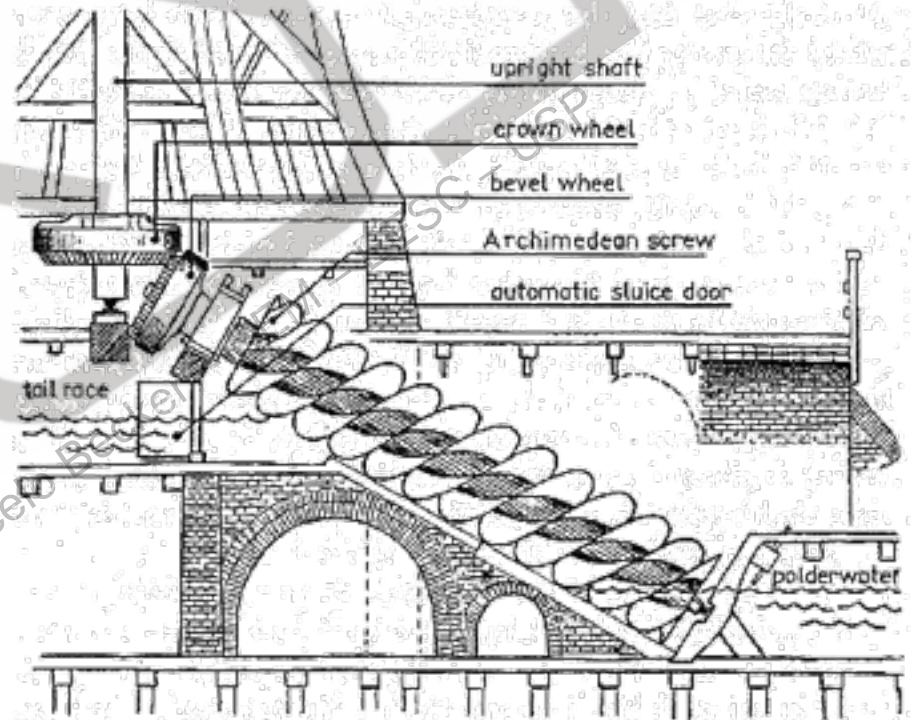
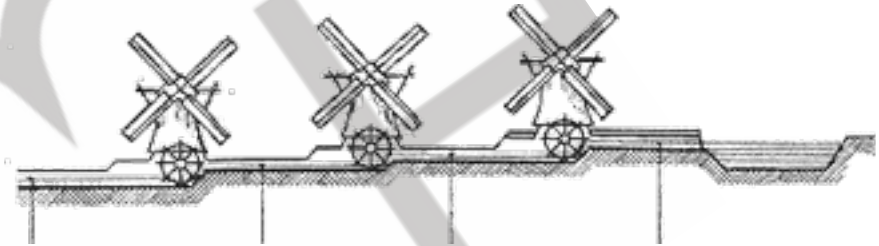
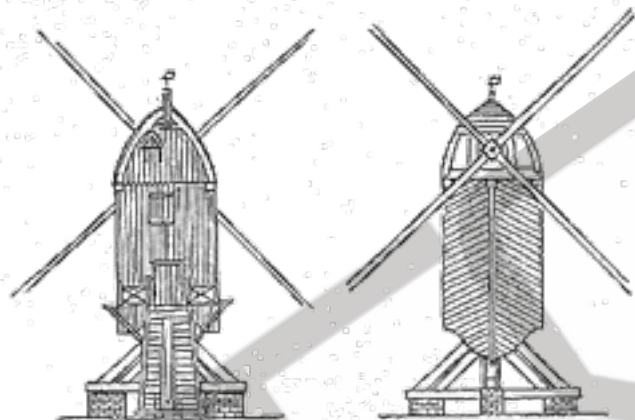
Histórico

Moinhos de Vento



Histórico

Moinho de Vento

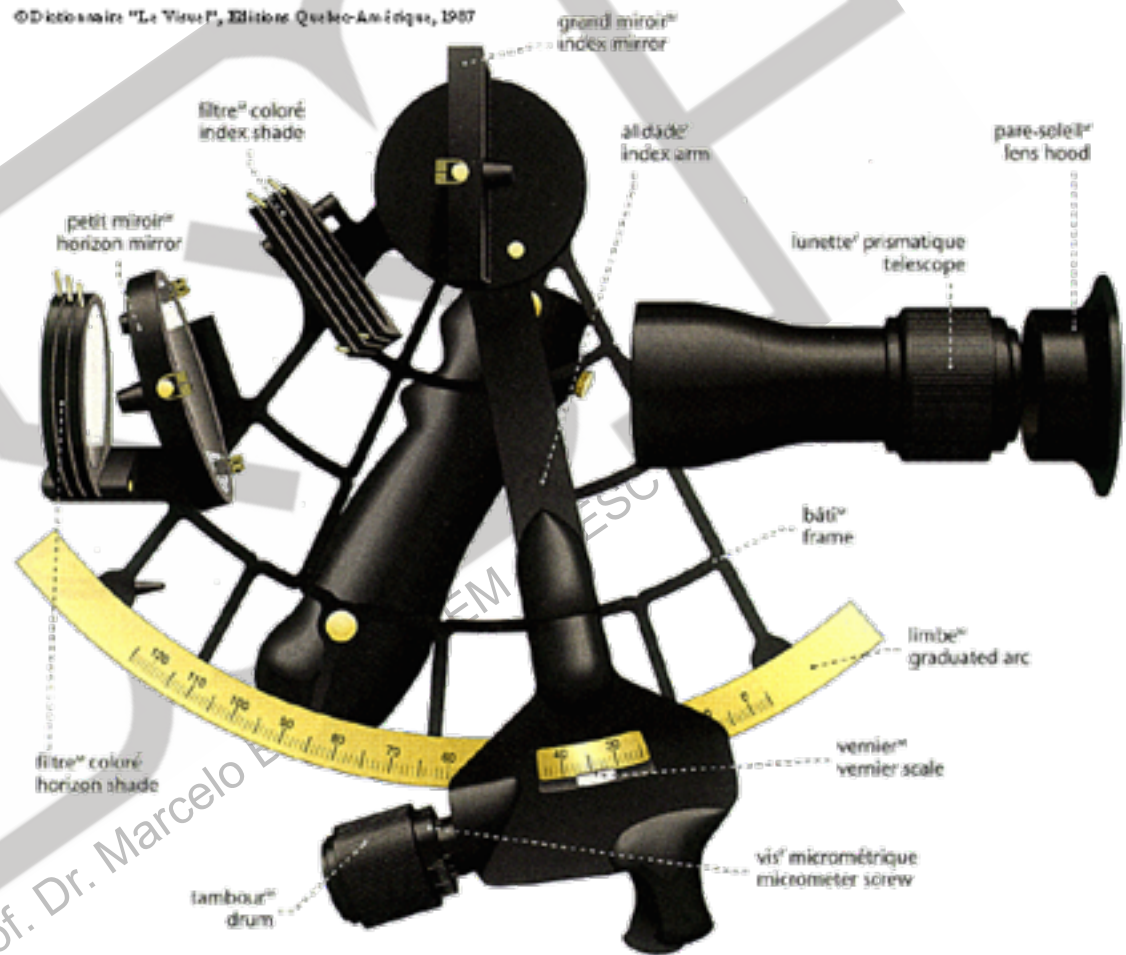


Histórico

Instrumentos de Navegação

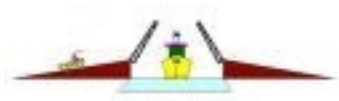


© Dictionnaire "Le Yacht", Editions Quêbe-Amérique, 1987



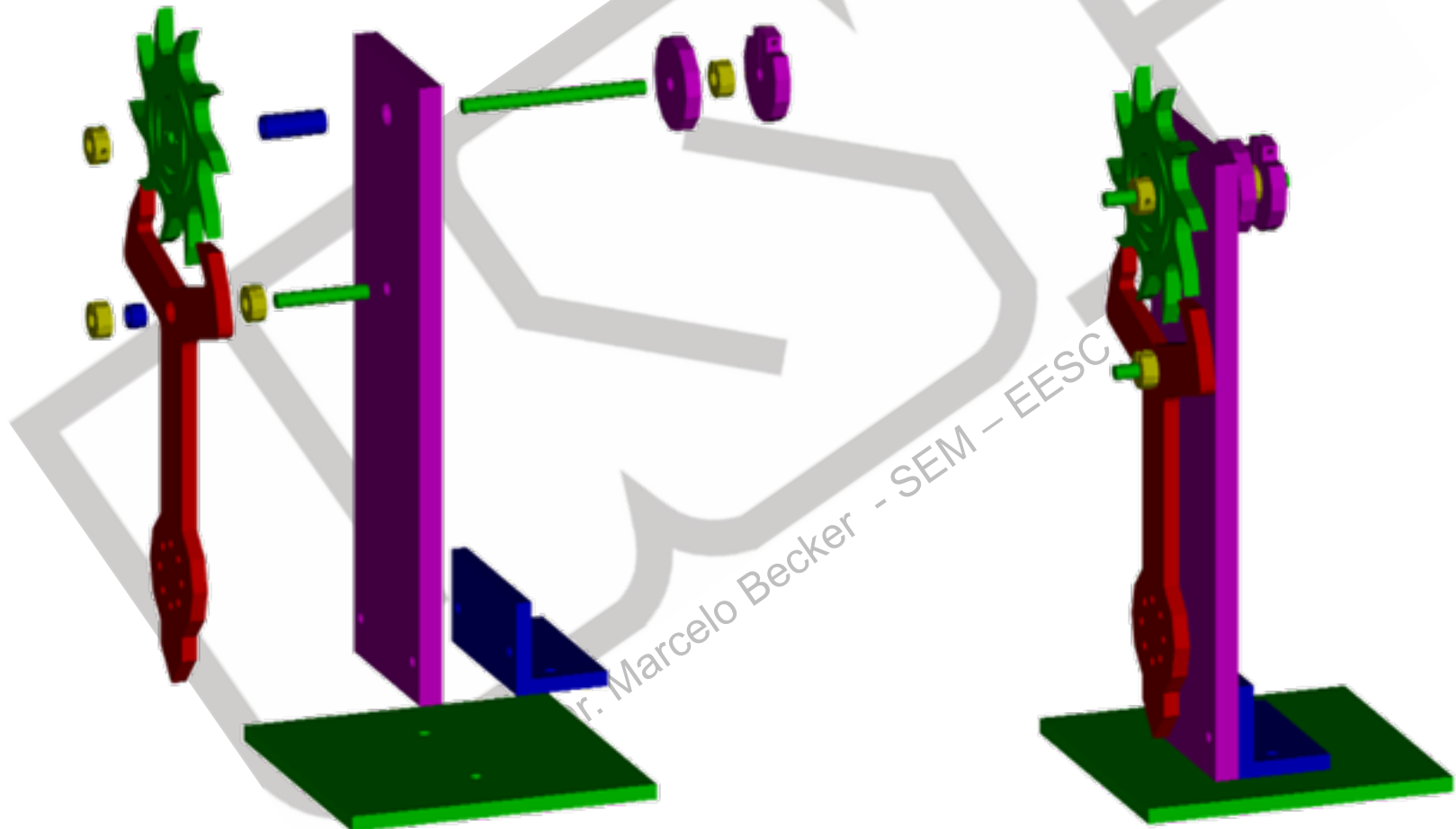
Histórico

Pontes Elevadiças - Basculantes



Histórico

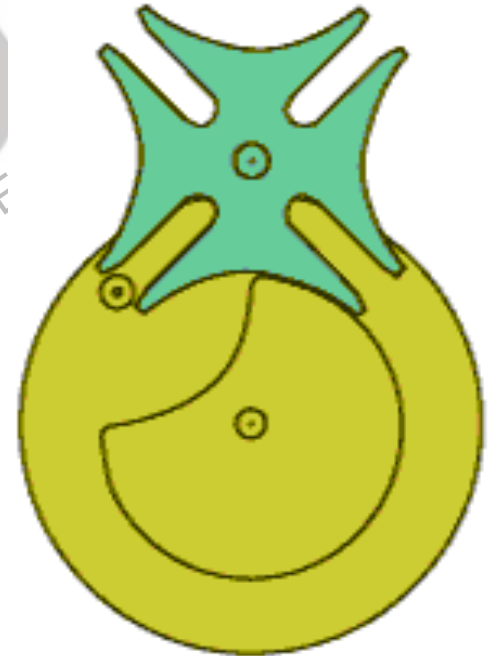
Relógios



Histórico

Relógios

Clockworks



Histórico

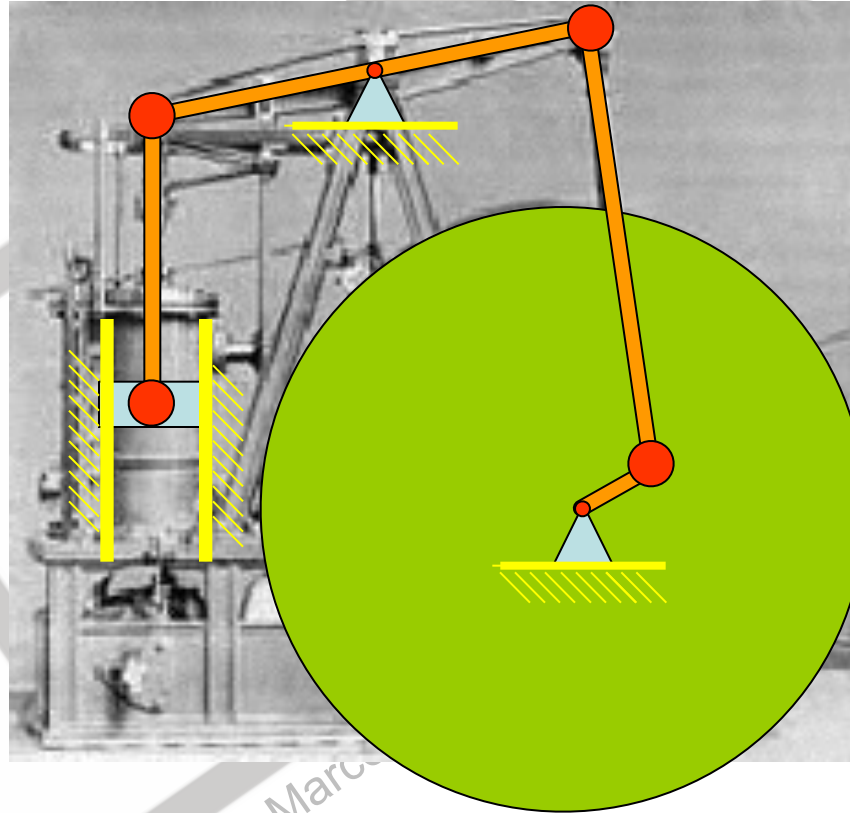
Máquina a Vapor – Século XVIII



James Watt

* 1736

+ 1819



1755 – Máquina a Vapor

Histórico

Teares

Revolução Industrial
Inglaterra – séc. XIX

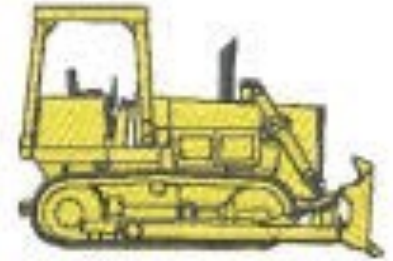


Sumário da Aula

- Informações sobre o Curso
- Introdução
- Histórico
- **Exemplos de Aplicação**

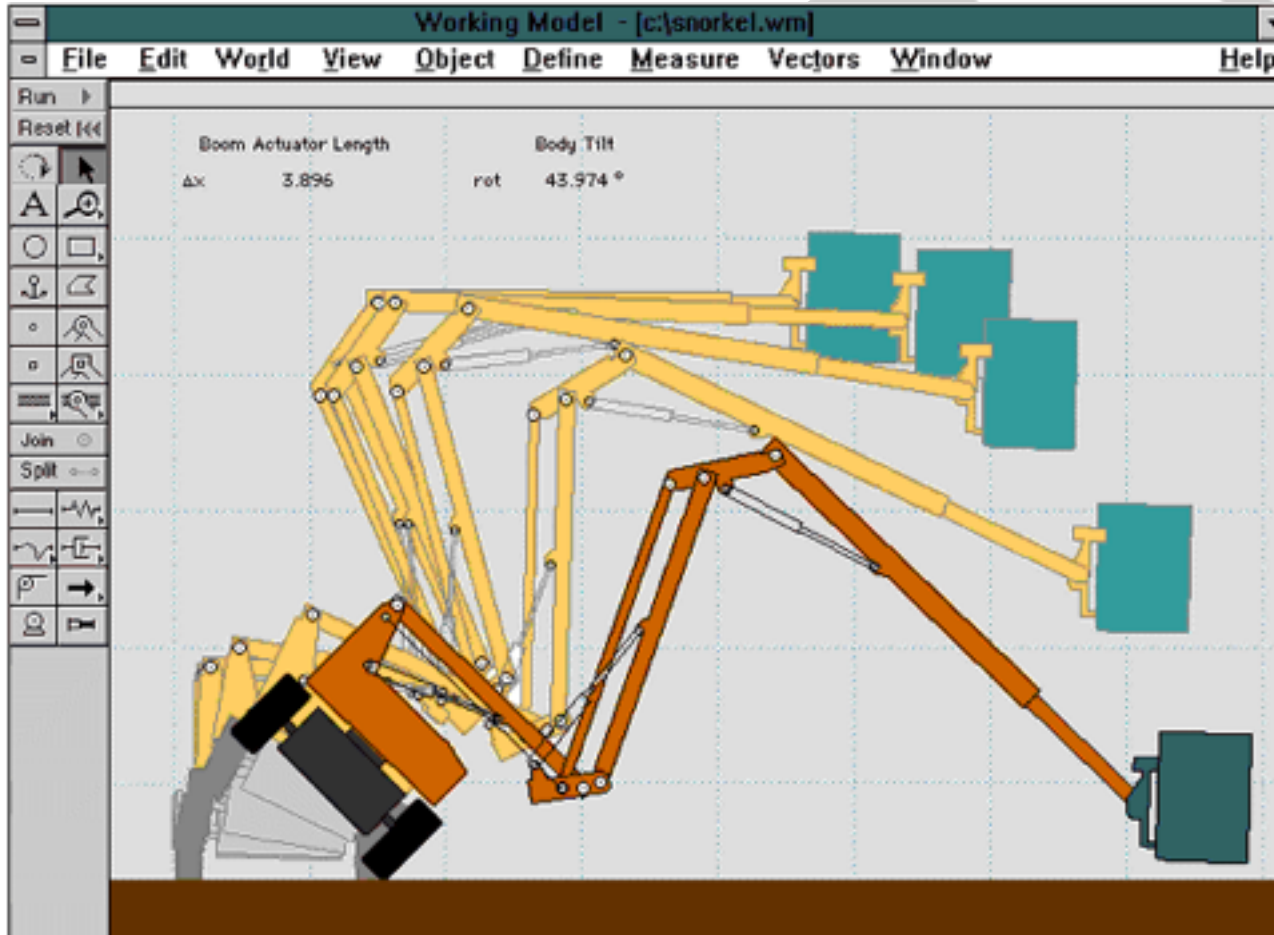
Exemplos de Aplicação

Indústria



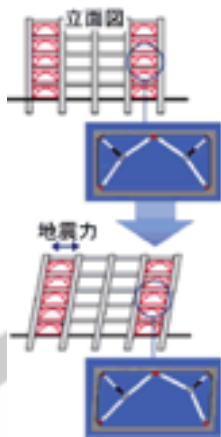
EESC-USP

Exemplos de Aplicação Indústria



Histórico

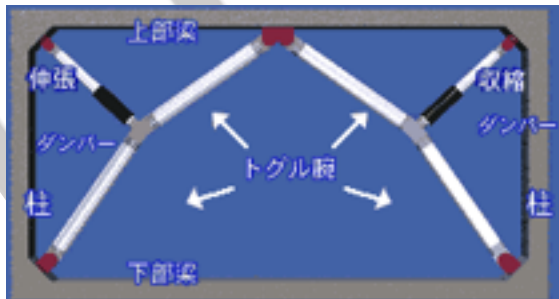
Indústria Civil - Terremotos



TYPE-1 両妻トグル制震



TYPE-2 構面外トグル制震



Exemplos de Aplicação

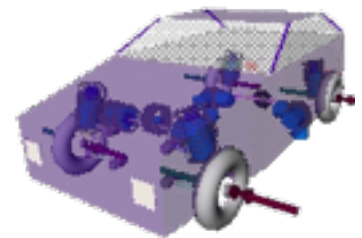
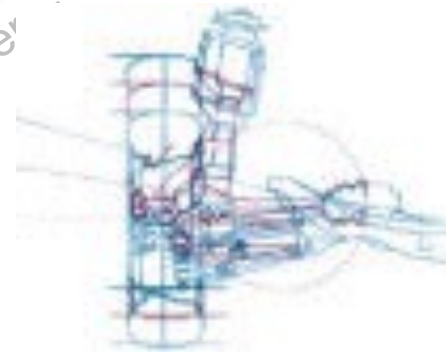
Bicicletas / Carros



EESC-USP

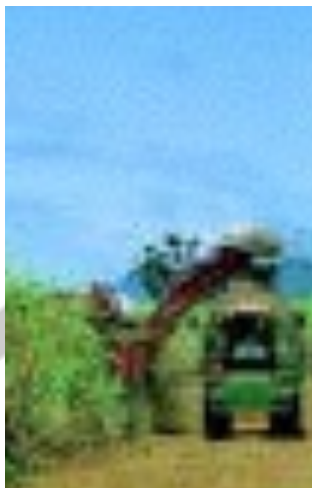


© M. Becker 2014



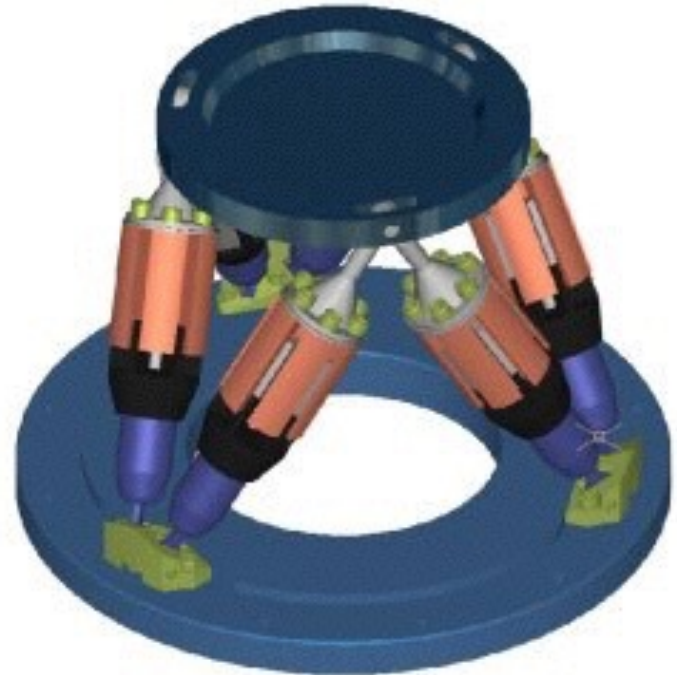
Exemplos de Aplicação

Agro-Industria

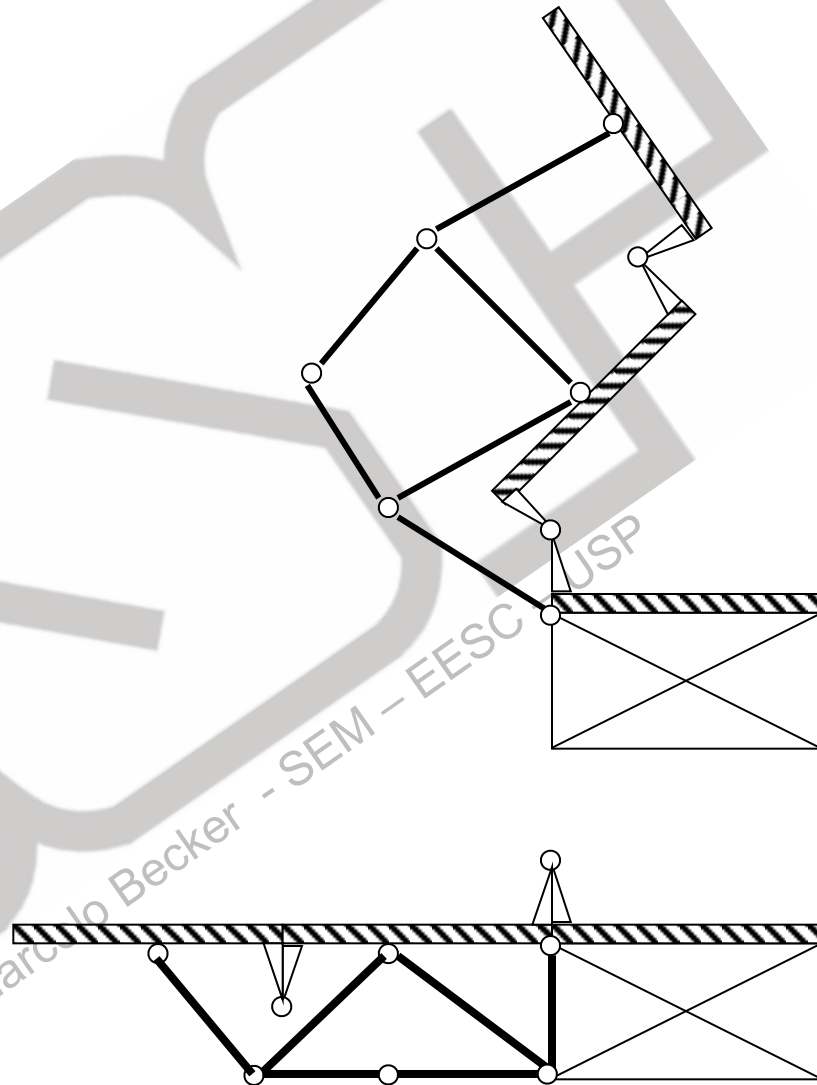


Exemplos de Aplicação

Simuladores

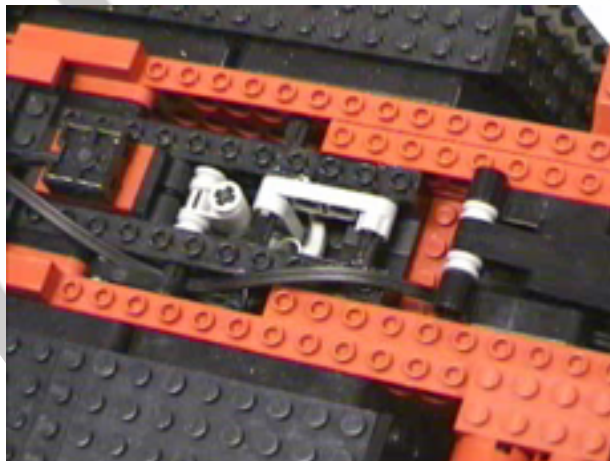
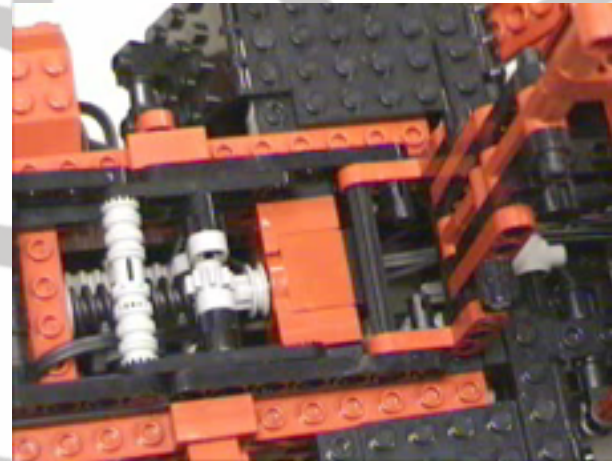


Histórico Satélites



Exemplos de Aplicação

Brinquedos - Lego



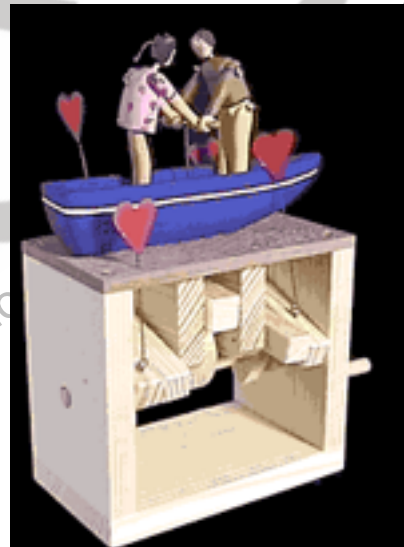
Exemplos de Aplicação

Brinquedos - Automata

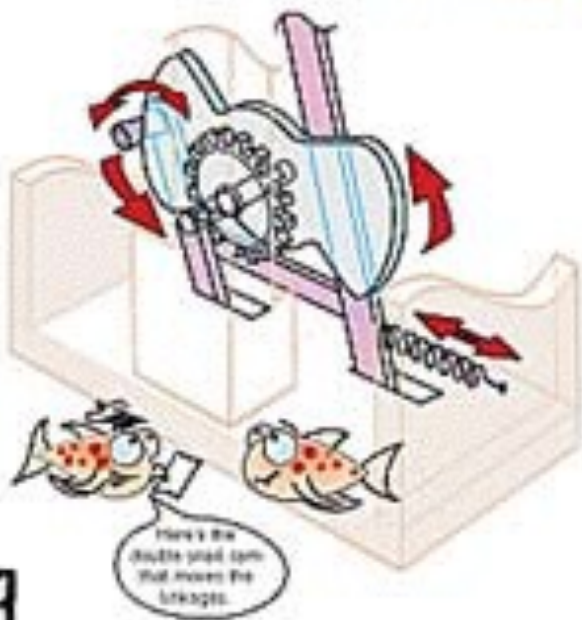
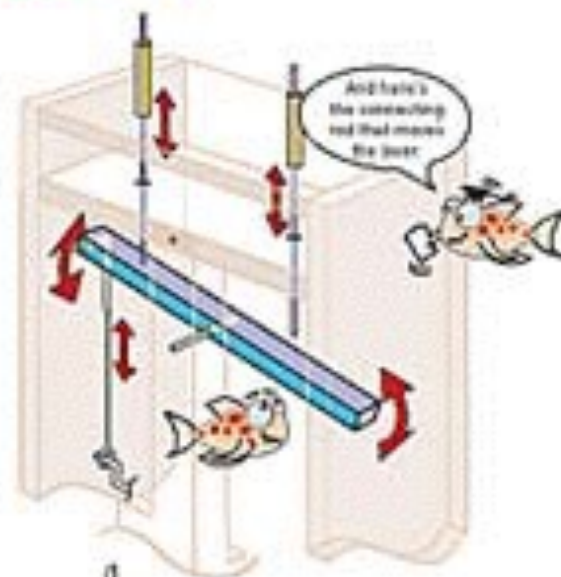


Exemplos de Aplicação

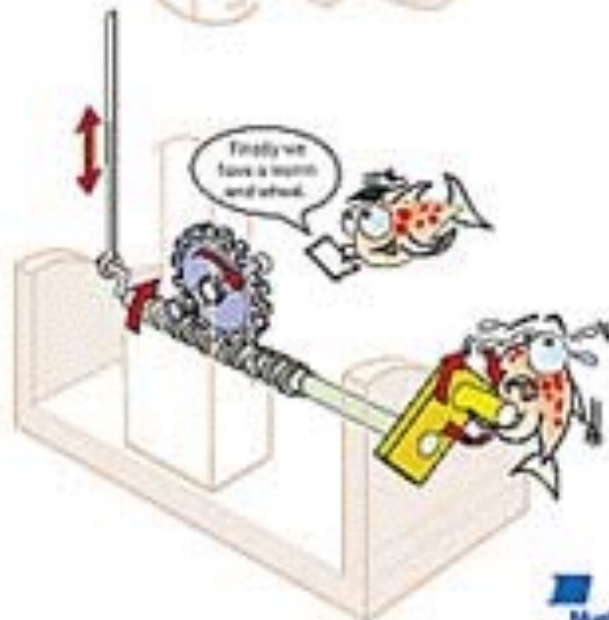
Brinquedos - Automata



MAKING MOVEMENT

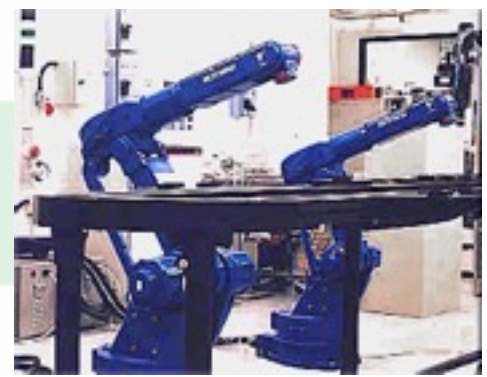


Turn the handle and the fish move left, right, backwards and forwards. This poster shows the mechanisms that create the movement. Can you explain what each one does? How do they work together?



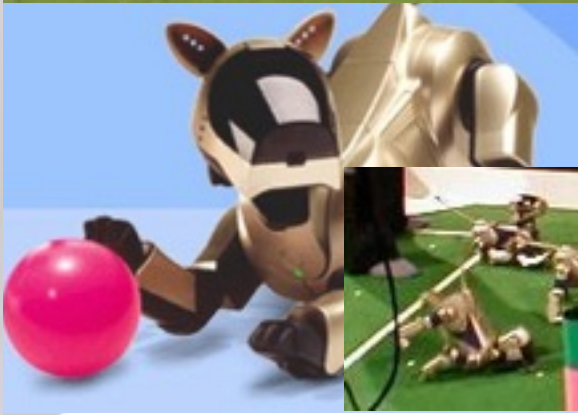
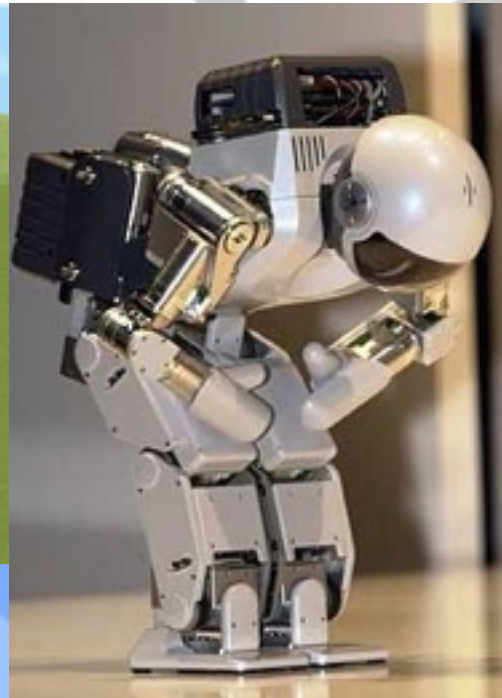
Exemplos de Aplicação

Robótica “Ontem”



Exemplos de Aplicação

Robótica “Hoje”



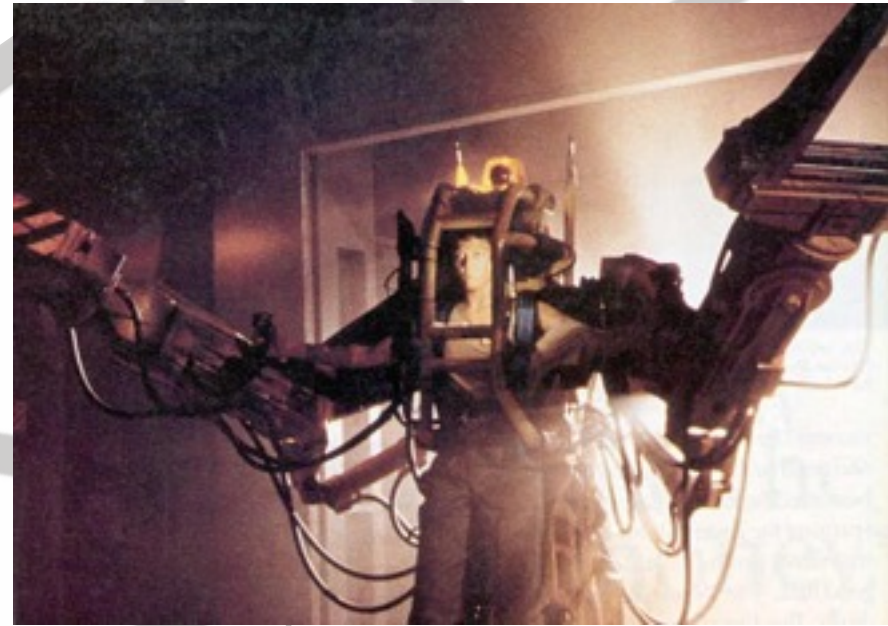
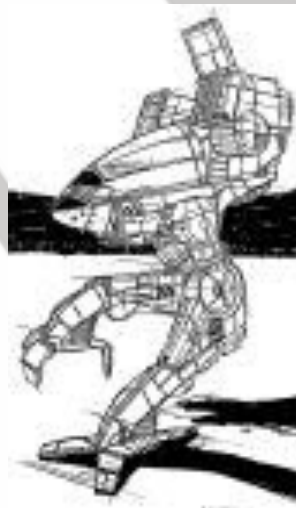
Exemplos de Aplicação

Robótica “Amanhã”

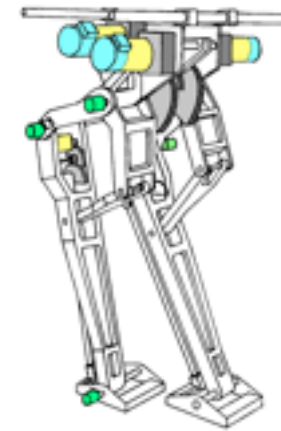
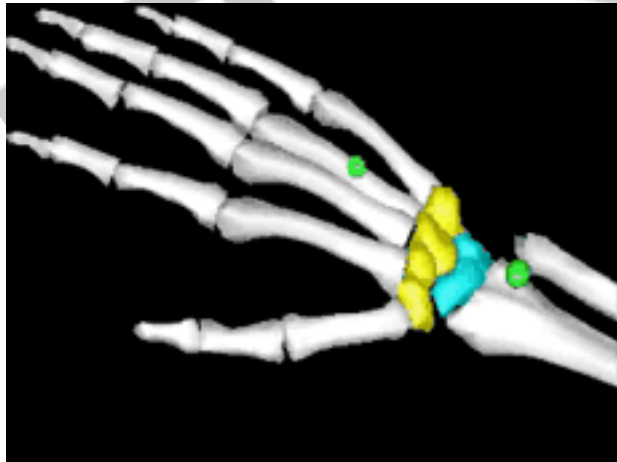
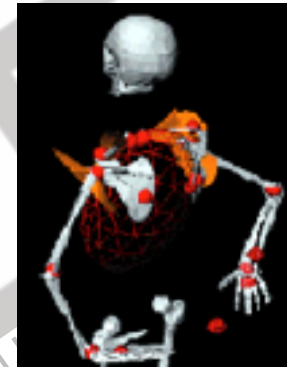


Exemplos de Aplicação

Robótica - Cinema



Exemplos de Aplicação Biomecânica



Perguntas?

Prof. Dr. Marcelo Becker - SEM - EESC - USP

Próxima Aula

- Graus de Liberdade
- Cadeias Cinemáticas
- Pense: Quantos movimentos tem sua mão?

