NRI: FND: COLLAB: Optimal Design of Robust Compliant Actuators for Ubiquitous Co-Robots

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1830360 → 1953908
(Gregg/Rezazadeh)
1830338 (Rouse)

Robert D. Gregg
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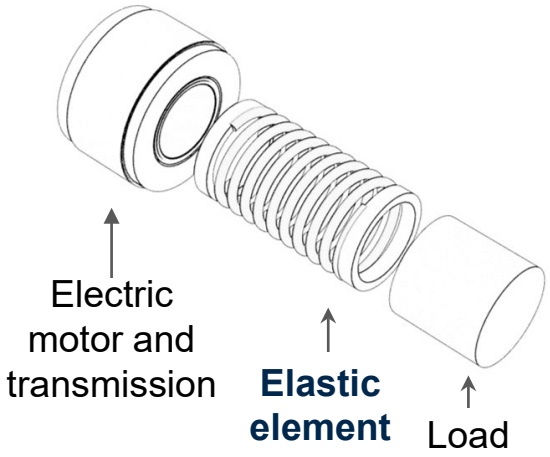
Series elastic actuators

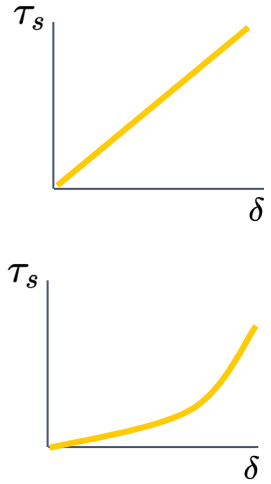


Poor selection of stiffness for given task may:

- Increase peak power
- Increase energy consumption

We lack fundamental understanding for robust design!

1. Design of **energy efficient series springs** as a **convex** optimization program



2. Robust feasible design of SEAs

3. Mechanical design of **optimal nonlinear springs**

Quadratic expression for energy consumption

$$E_m = a\alpha^2 + b\alpha + c$$

for spring compliance $\alpha = 1/k$

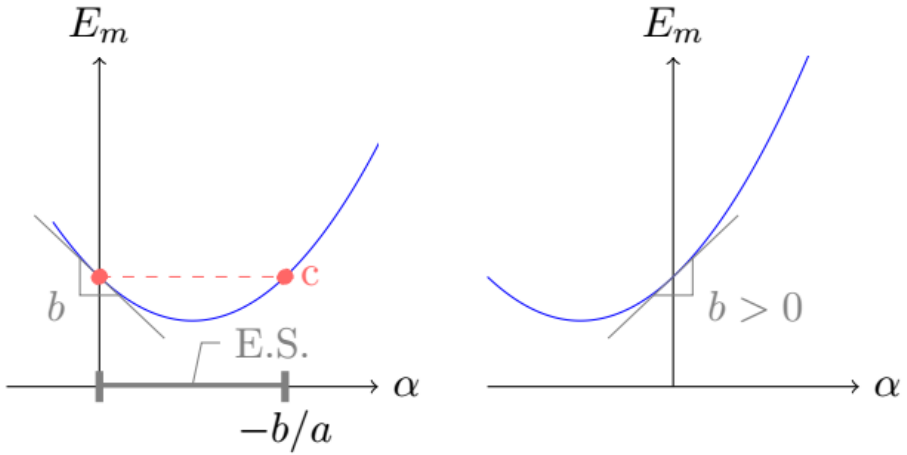
The quadratic expression is *convex*:

$$\frac{d^2 E_m}{d\alpha^2} = 2a \geq 0$$

***C* is the energy consumption of a *rigid* actuator:**

$$\lim_{k \to \infty} E_m = c$$

The **necessary** condition for a linear series elastic element to **save energy**: $b < 0$



Bolivar et al., *ICORR* 2019 Bolivar et al., *IROS* 2021

Thank you!

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See you at our poster!

Project website: http://mysite.du.edu/~srezazad/SEA-Optimization.html