ELL 707

01.01.2020

Disturbance Compensator Design

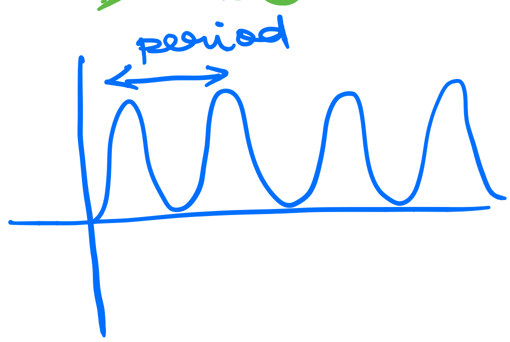
Paper:

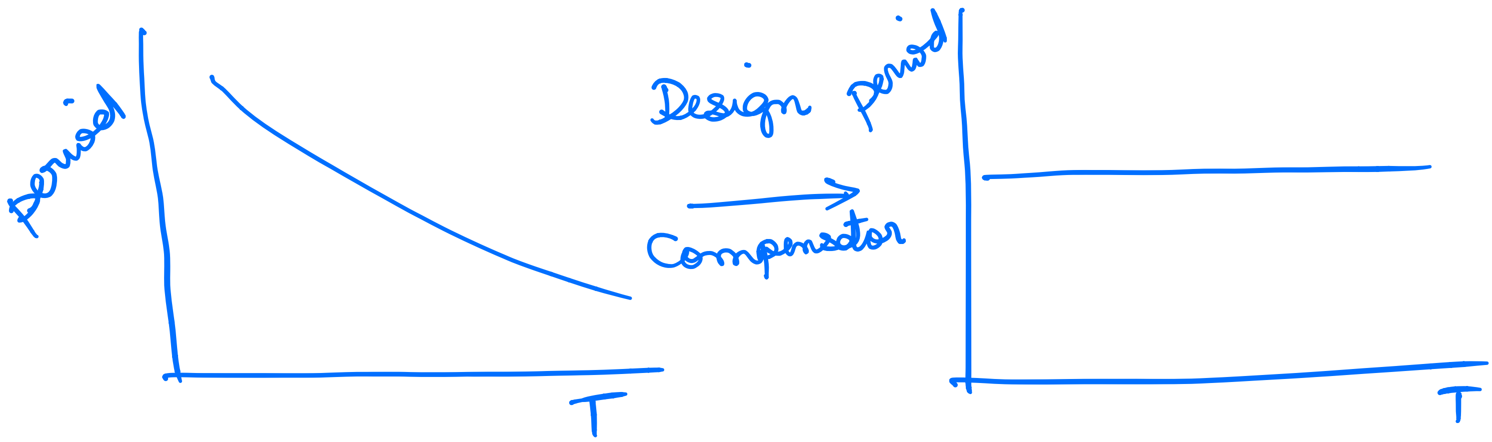
"Engineered Temperature Compensation in a Synthetic Genetic Clock"

Oscillator

Hussain et. al.

PNAS 2014





Would oscillators $\left\{ \begin{array}{l} LC \\ \text{mass spring} \\ \text{pendulum} \end{array} \right\}$ have temperature dependent periods?

$$\text{Period} = \frac{2\pi}{\sqrt{LC}}, \quad 2\pi\sqrt{\frac{l}{g}}, \quad 2\pi\sqrt{\frac{m}{k}}$$

can be temperature dependent

Oscillators

Systems

- What are oscillators? Different types
- Notion of Stability of an oscillator
- When do oscillations exist (as opposed to damping out, for example)?

Biology

- What are examples of biomolecular oscillators?

Design principles

- How to design an oscillator? (modelling) (device relations)
- Aspects of robustness, noise etc.
- Control the period, amplitude

- Role of feedback in generating these oscillations.

[Plan for coming lectures / weeks]

Examples: $\dot{r} \equiv \frac{dr}{dt}$, $\dot{\theta} \equiv \frac{d\theta}{dt}$, $t \equiv$ time

1. $\dot{r} = 0$

   $\dot{\theta} = 1\,\omega$, $r(0)$, $\theta(0)$ — initial condition

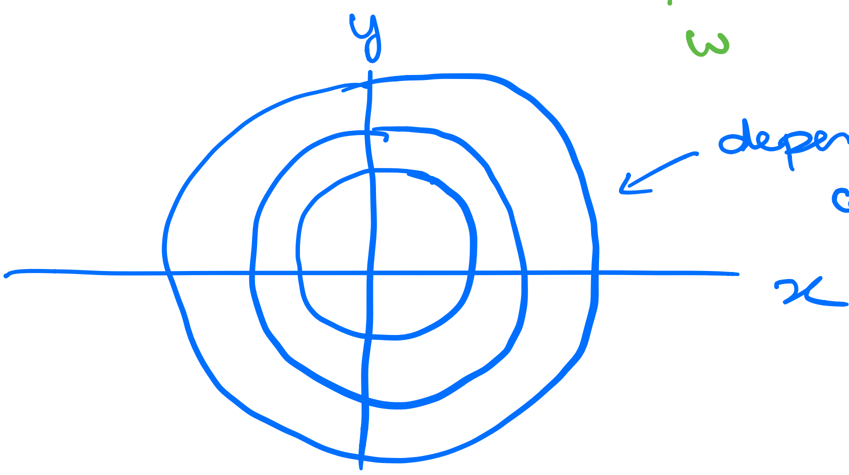
Solution?

$$\dot{r} = 0 \Rightarrow r(t) = \text{constant} = r(0)$$

$$\dot{\theta} = 1\omega \Rightarrow \theta(t) = \omega t + \theta(0)$$

$$x(t) = r(0)\cos(\omega t + \theta(0))$$

$$y(t) = r(0)\sin(\omega t + \theta(0))$$



depends on initial conditions

2. $\dot{r} = r(1-r^2)$

   $\dot{\theta} = 1$