

Exercise 1

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Stability (1)

Consider a linear system described by

$$\dot{X} = Ax(t)$$

and supposed that one of the eigenvalues of A is given by **-1+3i**. What can be said about the stability of the system?

Answer: the system is stable.



Stability (2)

Consider a discrete-time linear system and its corresponding transfer function G(z). Then:

Answer: The system is stable if the poles of G(z) are inside the unit circle.



Nyquist/Shannon

The Nyquist-Shannon theorem provides conditions to...

Answer: Determine the sample rate necessary to "reconstruct" a signal.



Delayed systems

Consider a stable linear system and a delay. Which of the following properties of the closed-loop system cannot be modified by the delay:

Answer: The gain (magnitude).



Nyquist criterion

Let $G(s)$ be the transfer function of a linear system, and $C(s)$ the transfer function of a PD controller. Suppose that one of the poles of $G(s)$ has a real part positive and the rest lie at the left-hand plane. If the closed-loop system is stable, how many times (and in which direction) the Nyquist plot of $C(s)G(s)$ encircles the point $(-1,0)$?

Answer: One in the counterclockwise direction.



Circle criterion

Which of the following statements is not true?

Answer: The circle criterion provides necessary conditions to determine the stability of a feedback scheme composed of a linear system and a static nonlinearity.



Analogues

Which pair does not represent an analogy?

Answer: Current-Pressure



Actuators

Is not a selection criterion for actuators:

Answer: Passive or active.



Miscellaneous (matching question)

- It is an example of a reference variable -- **desired angular position**
- To determine the stability of the error system (when designing an observer), we analyze the eigenvalues of the matrix -- **A-LC**
- It is an example of a rotational sensor -- **Tachometer**
- These actuators are (usually) big and powerful -- **Hydraulic actuators**
- It is an example of a manipulated variable -- **angular position**
- It is an example of a functional requirement -- **The system must not weigh more than 3 [kg].**
- It can be represented by a switch -- **ADC**
- The ZOH is used to mathematically represent a(n) -- **DAC**



Guest lecture (1)

One of the reasons for measuring the closed-loop system response after the control tuning process is...

Answer: The controller (customarily) needs to be discretized, which may affect the performance of the system.



Guest lecture (2)

How can we avoid aliasing?

Answer: By applying the result of the Nyquist-Shannon theorem.



Guest lecture (3)

How can we deal with spectral leakage?

Answer: Via windowing.



Guest lecture (4)

What was the main topic of the guest lecture?

Answer: What was the main topic of the guest lecture?