University Badji Mokhtar-Annaba
Department of Electronics
3rd year License in Automatique L3 (S5)
Academic year: 2025/2026

TP on Linear Systems Control (CSL)

TP4 : Study and analysis of systems in state space

Objective of the lab:
- Use MATLAB functions to analyze systems in state space.
Controllability and observability

1-Controllability criterion: Controllability is a characteristic property of the coupling between the input and output of the system and will therefore involve matrices A and B.
Theorem (Kalman Criterion)
An LTI system with a state dynamic equation,

$$\begin{cases} \dot{x} = Ax + Bu \\ y = Cx + Du \end{cases}$$

is controllable if and only if the controllability matrix, C, has rank n,

$$rang(\mathcal{C}) = rang\left(\left[B \vdots AB \vdots \cdots \vdots A^{n-1}B\right]\right) = n$$

$$rang(\mathcal{C}) = \texttt{ctrb}(A, B)$$

2-Observability criterion The notion of observability involves the matrices A and C. Theorem (Kalman Criterion): An LTI system of dynamic and measurement equations is observable if and only if the observability matrix, O, has rank n,

$$rang(\mathcal{O}) = rang\left(\begin{bmatrix} C \\ \cdots \\ CA \\ \cdots \\ \vdots \\ \cdots \\ CA^{n-1} \end{bmatrix}\right) = n$$

$$\mathcal{O} = \texttt{obsv}(A, C)$$

<u>Application: Study the properties for a system: a direct current motor represented in state form.</u>