MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, January 30th, 2025 at 13:30, D. Dan and Betty Kahn Building, Room 217.
Online: https://technion.zoom.us/j/3136048791?omn=95995849800

On Variation Bounding Systems Operators

Chaim Roth

Adviser: Dr. Christian Grussler

Many analytical and computational benefits of so-called positive systems, i.e., systems that map nonnegative inputs to nonnegative outputs have been observed in the past. However, it was not until recently that the scientific community has started to extend these benefits towards broader, as well as more refined classes of systems. The underlying tool for these extensions is the framework of total positivity, which generalizes nonnegative operator theory, i.e., operators that map nonnegative inputs to nonnegative outputs, to operators that leave the space of vectors with at most k sign changes invariant.

In this talk, we will start by discussing how this generalized property naturally appears in observability operators of linear time-invariant (LTI) systems when considering the problems of minimum-time control and step response analysis. We will see in discrete-time that such observability operators are characterized by the property of k+1-sign consistency, i.e., all minors of order k+1 must share the same sign. Subsequently, it is shown that this constraint is equivalent to the positivity of a set of related LTI systems. This equivalent characterization enables computational tractability via convex optimization and analytically reveals necessary pole constraints. We will conclude the talk by showing examples on bounding the number of sign changes of impulse responses, where will construct an example that shows that our findings strictly extend existing results.

Note: The seminar will be given in English.

Seminars Coordinator: Assoc. Prof. Gal Shmuel