

## MECHANICAL ENGINEERING STUDENT SEMINAR

Wednesday, August 17, 2022, at 13:30

Online: <https://technion.zoom.us/j/95806235548>

### Soft Landing using LQ Optimization for Non-Ideal Bodies

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Autonomous soft landing is a crucial mission during important aerial operations. Soft landing algorithms have been developed since the 1960s, starting with the development of the Apollo program. In the recent years, as a part of Vector Guidance, a Soft-Landing guidance law based on LQ optimization, has been presented in the literature. This was done for ideal vehicles; that is, ideal rigid body dynamics, without saturation.

In the present research we expand the guidance law to include the rigid body dynamics. In the first step, we approximate the rigid body dynamics to a first order transfer function with time constant  $\tau$ , and later we will deal with a more general case.

Another subject of this research is the time-to-go ( $t_{go}$ ) calculation during the soft landing. For an ideal system, the  $t_{go}$  equation is a simple quartic polynomial equation with an analytic solution, but for a non-ideal system the  $t_{go}$  equation may be very difficult to solve. We will present a new method to calculate  $t_{go}$  based on some characteristics of the LQ cost function.

We will test the developed guidance laws using simulations based on Simulink. The simulations will consider the system's parameters and  $t_{go}$  calculation methods.

Note: the seminar will be given in Hebrew