

Plant Poles & Zeros

Mechanical Engineering

Where the poles sit is the whole story of how a system behaves.

A transfer function is output over input in the s domain, and its poles decide how the system behaves.

STABLE

every pole left of the axis

MARGINAL

poles sitting on the axis

SYSTEM ORDER

the number of poles

- Poles are the roots of the denominator
- Any pole with a positive real part is unstable
- Distance left of the axis sets the decay rate
- Distance along the axis sets the ringing frequency
- Zeros shape the response, not the stability
- A right-half-plane zero makes the output dip first

LOOK FOR IT

A pole at minus two decays to a third of its value in half a second.

The poles come from the physics of the plant. Moving them is the entire job of controller design.