Eigenvalue

|  |  |
| --- | --- |
|  |  |

**2nd order systems**

|  |  |  |  |
| --- | --- | --- | --- |
| Damping factor | Pole location | Characteristic behavior | Step response |
|  | Two real, distinct roots | Overdamped |  |
|  | Two real, equal roots | Critically damped |  |
|  | Two complex conjugate roots | Underdamped |  |



|  |  |
| --- | --- |
|  | Process gain, To calculate see where the first peak occurs, and divide that by . |

**Lead-lag behavior**

**Poles and zeroes**

If zero is real, inverse response. If pole is real, unstable. As poles become more negative, the response is faster.

As the imaginary/real ratio increases, the response becomes more oscillatory.

**Dead time**

1st order Pade approximation 2nd order Pade approximation



**On-off control**



If If Else,

Dead band is a measure of how an output change must occur before the setting is changed. There is a natural trade between tighter output control and periodic switching. With a small dead band, there will be small fluctuations in output, but more frequent switching of the setting. As the dead band is increased, the fluctuations in output become larger, but the heater setting is switched less often.

**Proportional control**

A process with a positive gain requires a controller proportional gain that is also positive. A process with a negative gain would require a controller proportional gain that is also negative.

Valve gain:

|  |  |
| --- | --- |
| Controller transfer function |  |
| Valve transfer function |  |
| Process transfer function |  |
| Disturbance transfer function |  |
| Measurement (sensor) transfer function |  |



Response to setpoint change

