1 handout: slides

EOLQs

Control

Control

Planning Problems

Observability: complete, partial, hidden
State: discrete, continuous
Actions: deterministic, stochastic, discrete, continuous
Nature: static, deterministic, stochastic
Interaction: one decision, sequential
Time: static/off-line, on-line, discrete, continuous
Percepts: discrete, continuous, uncertain
Others: solo, cooperative, competitive

low-level planning

- stochastic effects: policy, ‘control law’
- continuous state: how to represent?

Model Predictive Control

used with ‘receeding horizon’ ($\approx$ real-time search)

simulate a bunch of controls (near nominal), pick best!

or steer to a bunch of states (near nominal), pick best!

flexible, dangerous

Break

- asst3
- projects
- wildcard class

P Control

$$u = K_P(x_r - \hat{x})$$

responsiveness vs smoothness
$=$ spring model
allows persistent error!
unstable with inertia!

PD Control

$$u = K_P(x_r - \hat{x}) + K_D \frac{d(x_r - \hat{x})}{dt}$$

dampen correction if error is changing a lot

$=$ dampened spring model

does nothing if persistent error is constant!

PID Control

$$u = K_P(x_r - \hat{x}) + K_I \int (x_r - \hat{x})dt + K_D \frac{d(x_r - \hat{x})}{dt}$$

removes any persistent error
however, 'wind-up'

widely used. not optimal or necessarily stable.

tune by hand, or
Thrun says coordinate-wise bisection search

Bisection Search

given f and initial guesses l and r

1. bracket a local minimum
   (a) try guess m in middle
   (b) if m smallest, done! (local min between l and r)
   (c) if l smallest, $r \leftarrow m$, $m \leftarrow l$ and move l left
       move l by at least original $r - l$ (double interval)
   (d) if r smallest, $m \leftarrow r$ and move r right
2. refine estimate
   (a) try lm between l and m.
   (b) if smaller than m, $r \leftarrow m$ and $m \leftarrow lm$
   (c) otherwise, try mr between m and r.
   (d) if smaller than m, $l \leftarrow m$ and $m \leftarrow mr$
   (e) otherwise m is smallest, $l \leftarrow lm$ and $r \leftarrow mr$
   (f) until range small or values close

See Also

optimal control: eg, Linear-Quadratic-Gaussian (LQG)

discrete control: eg, Markov decision processes

state estimation aka filtering: eg, Kalman filter, particle filter

EOLQs

Please write down the most pressing question you have about the course material covered so far and put it in the box on your way out.

Thanks!