

Control Barrier Functions - Quadratic Programming

Core Idea:

- CBF's are tools that guarantee a system stays within a safe set - **Prevent Dangerous Behavior!**
 - Can be combined w/ QP
- Use a "safe set" to define safe region
- Define barrier function $h(x)$
 - (+) in safe set, 0 on boundary, (-) outside

Simple Example: Safe Robot Navigation (1D)

Setup:

Robot at position x moving at $v = u$

We want it to stay within $0 \leq x \leq 10$

control input

Step 1: Define the Safe Set

$$S = \{x: 0 \leq x \leq 10\}$$

Step 2: Choose Barrier Function

$$h_1(x) = x$$

$$h_2(x) = 10 - x$$

$$\dot{h}_1(x) = \dot{x} = u$$

$$\text{so } u + y_1 x \geq 0$$

$$u \geq -y_1 x$$

