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Autonomous robotics: Action, Perception, and Cognition

May 3, 2024

Exercise 2 Attractor dynamics for obstacle avoidance

Please upload solutions on the web page before midnight on **May 10, 2024** (Friday).

In the lecture, we saw how to generate movement by generating a time course of vehicle heading, $\phi(t)$, from a dynamical system defined over ϕ. The contribution of a single obstacle to this dynamics is given by

$$\dot{\phi} = \alpha(\phi - \psi) \exp\left[-\frac{(\phi-\psi)^2}{2\sigma^2}\right]$$

where ψ is the direction in which an obstacle lies, α is the strength of repulsion, and σ determines the width of this contribution. [For background, read through the first part of the paper Schöner, Dose, Engels (1995) made available on the web page (end on page 223 before "(3) Neural field dynamics".]

1. Plot the first factor and describe the geometrical meaning of the two parameters, ψ and α.

2. Plot the second factor and describe the geometrical meaning of the two parameters, ψ and σ.

3. Plot the product. Is the slope of the dynamics at $\phi = \psi$ affected by the second factor? Why or why not?

4. Plot the time course of heading direction that results from this dynamics when the initial heading direction, $\phi(0)$ is (a) $< \psi$, (b) $> \psi$, (c) $= \psi$. These plots are qualitative based on your mental "simulation" of the dynamics.

5. Plot the same time courses when α is larger.

6. State what happens when the initial heading, $\phi(0)$ is far from ψ: $|\phi(0) - \psi| >> \sigma$?