

April 16, 2025

Exercise 2 Attractor dynamics for obstacle avoidance

Please upload solutions on the web page before midnight on **April 23, 2025** (Wednesday).

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 : $|\phi(0) - \psi| \gg \sigma$?