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Autonomous robotics

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Exercise 3 Attractor Dynamics for vehicle motion planning: sub-symbolic approach

Read the paper by Bicho, Mallet, Schöner (2008): Using Attractor Dynamics to Control Autonomous Vehicle Motion. In: *Proceedings of the 24th Annual Conference of the IEEE Industrial Electronics Society* (IECON98), p. 1176-1182, Aachen, Germany (reprint available on the web page). This covers much of the contents of the lecture on the sub-symbolic attractor dynamics approach.

1 Obstacle dynamics Eqs. 1, 2, 3 of the paper

You have analyzed Eq. (1) in last week's exercise. Now we'll focus on how the terms depend on sensory information in the "sub-symbolic" approach.

1. Consider the obstacle force-let of Equ (1): Does the front sensor on the vehicle contribute to obstacle avoidance?

2. Make a plot of Eq. (2): $\lambda(d)$, where d is the distance measured by a sensor. Explain the geometrical meaning of the two parameters, β_1 and β_2 and mark the plot to highlight that meaning.

3. Give a geometrical justification for Eq. (3). [Hint: Draw a circular vehicle, the detection range, $\Delta\Theta$, of a single sensor (approximated as the angular width of the sensor cone that has its origin in the center of the vehicle), an obstacle that covers the entire detection range at the measured distance, d, and the robot at that distance. Interpet the $R/(R+d)$ as the tangent of an angle (R short for R_{robot}).]

4. Plot Eq. (3) numerically by giving reasonable values to the parameters (e.g. $\Delta\Theta = 60\,\text{deg}$, $R = 0.2$ meters, and $d >= R$).

5. Plot two force-lets of Eq. (1) that are separated by $1.25 * \Delta\Theta$ into the same plot together with their sums. Assume these forces reflect two neighboring sensors whose sensor cones of width $\Delta\Theta$ touch exactly without overlap. Make that plot for a short distance (e.g. $d = 2R$) and a large distance (e.g. $d = 8R$) (assume that same distance applies for both force-lets). Interpret the difference you see between these two cases.