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Autonomous robotics: Action, Perception, and Cognition

May 16, 2024

Essay exercise 4 Attractor dynamics on a low-level vehicle

Please upload solutions on the web page before midnight on **June 6, 2024** (Thursday).

This essay exercise is worth triple bonus points. We ask you to read a longer book chapter in some detail and to test your understanding by summarizing important points in your own words. Write structured text that a reader who has not read the paper may follow! Use complete sentences (English or German). It is a good idea to use illustrations, which you should explain in text as well. If you want to copy illustrations from the chapter, reference them. You may work in teams, but must submit your own version of the essay that is not text-identical (or almost identical) with those of your colleagues. The length of the text should be appropriate to convey the ideas and depends on your choices. But because we are often asked about that: 10 pages may be a reasonable order of magnitude.

The Chapter 4 of the doctoral disseration of Estela Bicho (now a professor at the University of Minho in Portugal) provides a detailed description and analysis of what we have called the "sub-symbolic" variant of the attractor dynamics approach. This chapter is available on the web pages. It can be read independently of the rest of the thesis (I copied the table of contents into the file so you see what else is in that thesis).

Read the chapter as a whole. Then structure an essay, about key ideas of the paper. The essay is not meant to be a plain summary or re-telling of the paper, but a discussion focussed on specific points outlined below. Naturally, you will go back to the chapter as you work on those specific issues.

1. Write an "abstract" that summarizes the key insights this chapter provides.

2. Why does the obstacle avoidance contribution become broader in angular range as an obstacle is approached? (Use Figure 4.5 to understand this.)

3. Explain the issue of "invariance" of the dynamics by comparing Figures 4.3 and 4.7.

4. In Figure 4.15, the robot vehicle goes through a bifurcation in time, as it moves foward. Explain. Use the top panel in Figure 4.18 as well.

5. As the vehicle moves, the bearings of obstacles and targets change as illustrated in Figure 4.10. The text arond that figure explains, that the robot needs to drive sufficiently slowly so that the real heading direction remains close to the shifting attractor ("tracks" the attractor). State this idea on your own, without going into the mathematical details and illustrate it by referring to Figure 4.18.