Chapter 4

Behaviour Analysis

4.1 Introduction

This chapter describes the decomposition of the target behaviour into simpler behaviours. The product is a structured behaviour that should be easily impressed into a modular controller architecture.

4.2 Behaviour Decomposition

The requirements on the target behaviour were stated in an informal manner in the previous chapter. It is repeated here for convenience of analysis:

It is desired to have the robot turn towards and approach a light source placed at some location either inside the arena or suspended at some point outside of it. In approaching the light, the robot is to avoid obstacles, walls, and deadlock positions.

From this behavioural specification, we may initially infer the following two basic behaviours:

- *seeklight*: move towards a light source
- *avoidobst*: avoid obstacles

The interactions among behaviours can be expressed in an algebraic form. By way of review, the methodology specifies the following types of interaction dynamics:

- Independent Sum: two or more independent behaviours are performed at the same time, written as $\alpha|\beta$.
- Combination: two or more homogeneous behaviours (behaviours involving the same actuators) are combined into a resulting behaviour, written as $\alpha+\beta$.
- Suppression: a behaviour inhibits a competing one, written as $\frac{\alpha}{\beta}$
- Sequence: a behaviour is built as a sequence of simpler behaviours, written as $\alpha!\beta$.
- Repeated sequence: a sequence is repeated forever, written as $\sigma*$.

The two behaviours above, although simpler than the overall behaviour, are themselves still complex. For instance, we may view the *seeklight* behaviour is a combination of finding the light and then going to it. In the interaction algebra given above, we may write *seeklight*=(*findlight*!*gotolight*) . However, for the purpose of this work, we will reasonably assume that the necessary sequencing of the sub-behaviours can be taught to the learning system (ie, the recurrent neural network) since the ability to learn sequences is a demonstrated capability of these networks.

Combining *seeklight* and *avoidobst* using the “interaction algebra”, we write the desired overall behaviour as follows:

The form above makes sense. The light seeking behaviour must always give way to (or is suppressed by) the obstacle avoidance behaviour. The only condition of the specified target behaviour that has not been addressed in this form is the avoidance of deadlock positions. Deadlocks have been described as positions in which the robot "mindlessly" strives for an unachievable goal, usually caused by some form of perceptual aliasing or lack of memory.

In the context of this work, a deadlock was viewed as any position in which the *avoidobst* behaviour was active but was unable to provide a satisfactory action or combination of actions that leads the robot out of contact with an obstacle. This type of failure has been called "reactive stupidity" [Sharkey 96] and an example of such behaviour was given previously.