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SELF-LEARNING BALANCING SYSTEM FOR A ROLLING AND FALLING DISC

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We propose to develop a 'Self-Learning Balancing System for a Rolling and Falling Disc' where a disc rolling along a plane, learns on its own how to keep the balance of it.

The proposed system is expected to follow the same approach as what the humans do when it comes to learning how to balance the body, which is the approach of learning from one's past experience. As a result, the control system needs no prior knowledge about the dynamics of the system that needs to be balanced. Here, the focus is on reinforcement learning methods which help to choose actions which maximizes the possibility of reaching the expected outcome which in this case is, balancing the disc. The typical approach is to use a neural network. In this research, we plan to implement a table based self-learning procedure referred to as the 'Tabular Method'.

The 'Tabular Method' uses SARSA (State - Action - Reward - State - Action)' algorithm. The experience gathered by the system is stored in a table and it is updated every time an action is taken, based on the reward gained (in this case, whether the action taken helped to keep the balance of the disc or not)

To test a learning procedure, we need to apply it on the system that needs to be balanced (which in this case is the rolling and falling disc). Since it is a very tedious task, the best way to test the system is to model it in a virtual environment. We modeled the motion of a rolling and falling disc in a virtual environment using MATLAB Simulink. Using the developed simulator, the behavior of the output motion parameters could be observed subject to a control system following a particular learning procedure.

At the end, we simulated using the simulator, and plotted the roll angle of a coin under the control of our balancing system. At the initial stage, due to the zero knowledge of the system, it performed some random actions to balance the coin and failed. However, after a sufficient number of iterations, the system gained experience and maintained the balance of the coin perfectly for a long time.