Application of Hopfield neural network on the energy-saving robot path finding and robot arm control.

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Abstract

Robots are important tools in nuclear power plants since they could receive radiation without doing damage other than economy. It could be foreseen that once a material for robot fabricating that is radiation-resist enough, robot will be very universal in nuclear power plants. On the other hand, algorithms controlling the robot will be very important too. The complicated ground conditions in nuclear power plants require the robot to be able to climb stairs, avoid or step over various kinds of obstacles and make right decisions for saving energy.

Introduction

1.1 Literature review

1.2 Choice of technique

1.3 Projects to implement

Hopfield neutral space

2.1 Principles

2.2 Advantages and disadvantages

Innovative algorithms to use for the two projects

3.1 Energy-saving path finding

3.2 Multi-arm robot

Optimizations of computer code

4.1 Vectorization

4.2 Numba and code modifications

4.3 Pre-calculation of robot's coordinates (Project 2 only)

Calculation of the robot's presence (spatial coordinates that the robot occupies) is rather resources expensive. Since the robot's move in space could be regraded as translation, it could be pre-calculated. Presences of the robot in different places could be obtained by simple addition of the presence of the robot of same arm configuration and the difference in the coordinates of their origin point. Let $\mathcal{R}$ denote the set of points that are occupied by the robot at origin point $(0, 0)$. Then the set of points occupied by the robot of same arm configurations at point (x_0, y_0) will be $\{(x + x_0, y + y_0)|(x, y) \in \mathcal{R}\}$

For a neuronal space of size 192×18, without pre-calculation, generation of neuronal space takes about : 44.5 s. With pre-calculation, generation of neuronal space takes about : 0.41 s, the preparation of coordinates takes about 0.14 s.

Results and discussion

5.1 Energy-saving path finding

5.2 Multi-arm robot