

The background features a dark blue gradient with faint, light blue circular patterns. On the left side, there are several concentric circles with degree markings ranging from 40 to 260. Some of these circles have arrows indicating a clockwise direction. The overall aesthetic is technical and futuristic.

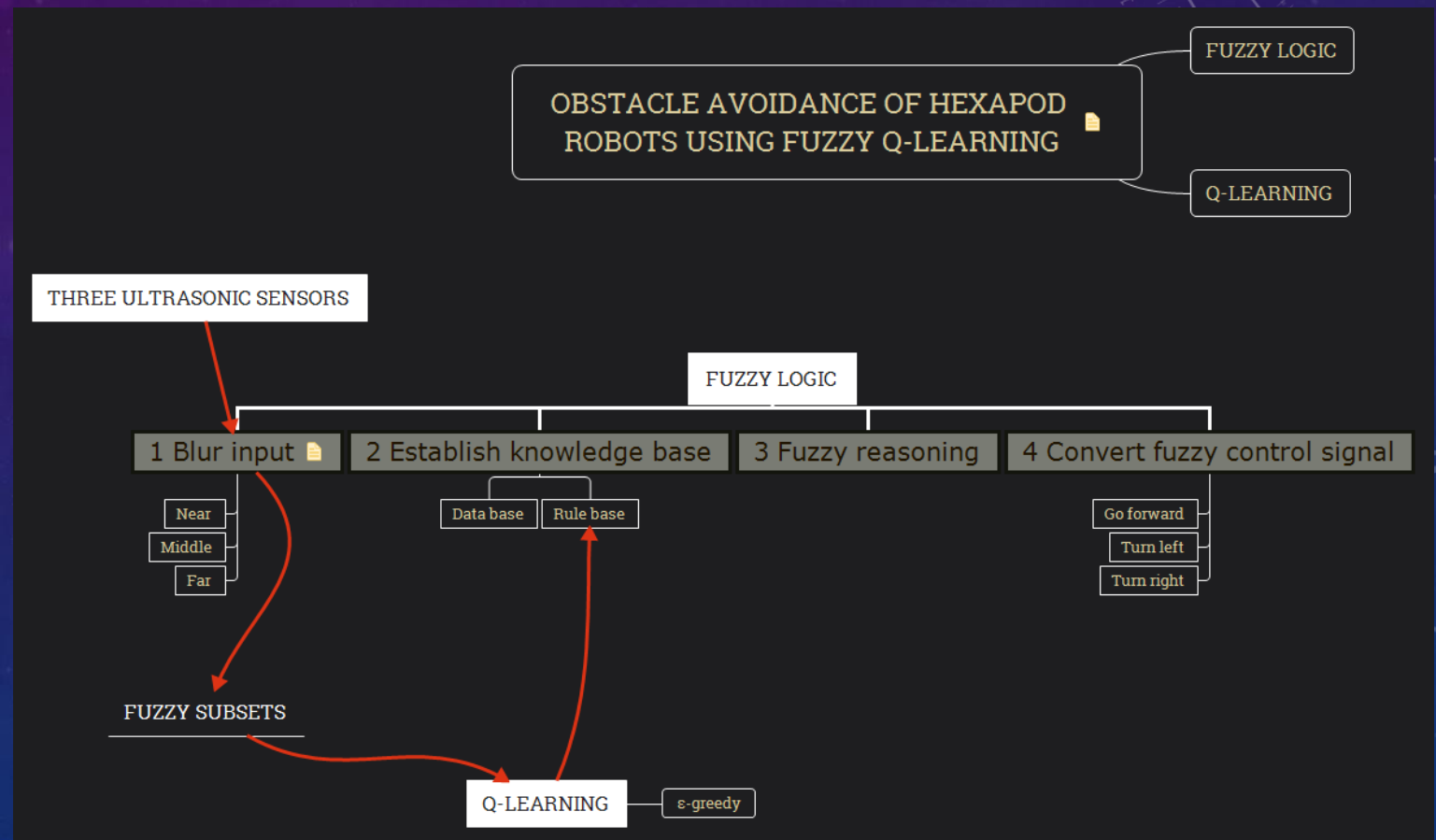
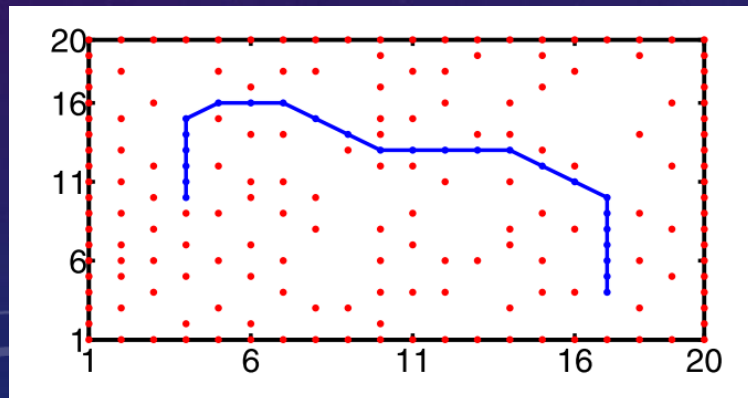
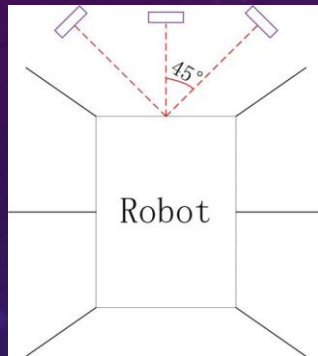
# HEXAPOD ROBOT CONTROL SYSTEM

3<sup>RD</sup> MEETING – 2019/12/13

My Library		Author	Year	Title	Rating	Journal	La
All References	(18)			Mobile Robot Navigation and Obstacle Avoidance Techniques: A Review			20
Configure Sync...				Mobile Robot Navigation and Obstacle Avoidance Techniques: A Review			20
Recently Added	(3)	● Altendorfer, R.; Moore, N.; Komsuolu, ...	2001	RHex: A biologically inspired hexapod runner	★★★★★	Autonomous Robots	20
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Trash	(0)	● Chai, X.; Gao, F.; Qi, C. K.; Pan, Y.; Xu, Y. ...	2017	Obstacle avoidance for a hexapod robot in unknown environment		Science China-Technological Sciences	20
My Groups		● Chen, C. H.; Wang, C. C.; Wang, Y. T.; W...	2017	Fuzzy Logic Controller Design for Intelligent Robots		Mathematical Problems in Engineering	20
Gait	(1)	○ Kai-Hui Chi	2011	Obstacle avoidance in mobile robot using Neural Network	★★		20
Non-intelligent	(1)	● Cully, A.; Clune, J.; Tarapore, D.; Mouret...	2015	Robots that can adapt like animals		Nature	20
Review	(1)	○ Hong, J.; Tang, K. Q.; Chen, C. L.	2017	Obstacle Avoidance of Hexapod Robots Using Fuzzy Q-Learning	★	2017 Ieee Symposium Series on Computa...	20
SelfRecovery	(2)	○ Hong, J.; Tang, K. Q.; Chen, C. L.	2017	Obstacle Avoidance of Hexapod Robots Using Fuzzy Q-Learning	★	2017 Ieee Symposium Series on Computa...	20
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FuzzyLogic	(5)	● Huang, B. Q.; Cao, G. Y.; Guo, M.	2005	Reinforcement learning neural network to the problem of autonomous mobile robot obstacle avoidance		Proceedings of 2005 International Conf...	20
NeuralNetwork	(4)	● Najmurokhman, A.; Kusnandar; Sofya...	2018	Design and Implementation of Fuzzy Logic Controller for A Class of Hexapod Mobile Robot		2018 Electrical Power, Electronics, Com...	20
Q-Learning	(2)	● Patrick Reignier	1994	Fuzzy logic techniques for mobile robot obstacle avoidance			20
		● Zhang, Y. N.; Wang, J.	2004	Obstacle avoidance for kinematically redundant manipulators using a dual neural network		Ieee Transactions on Systems Man and ...	20
		● Zhao, X. C.; Luo, Q. S.; Han, B. L.	2008	Research on the Real Time Obstacle Avoidance Control Technology of Biologically Inspired Hexapod Robot		2008 7th World Congress on Intelligent...	20
		● Zhao, Y.; Chai, X.; Gao, F.; Qi, C. K.	2018	Obstacle avoidance and motion planning scheme for a hexapod robot Octopus-III		Robotics and Autonomous Systems	20

EndNote library

# OBSTACLE AVOIDANCE OF HEXAPOD ROBOTS USING FUZZY Q-LEARNING



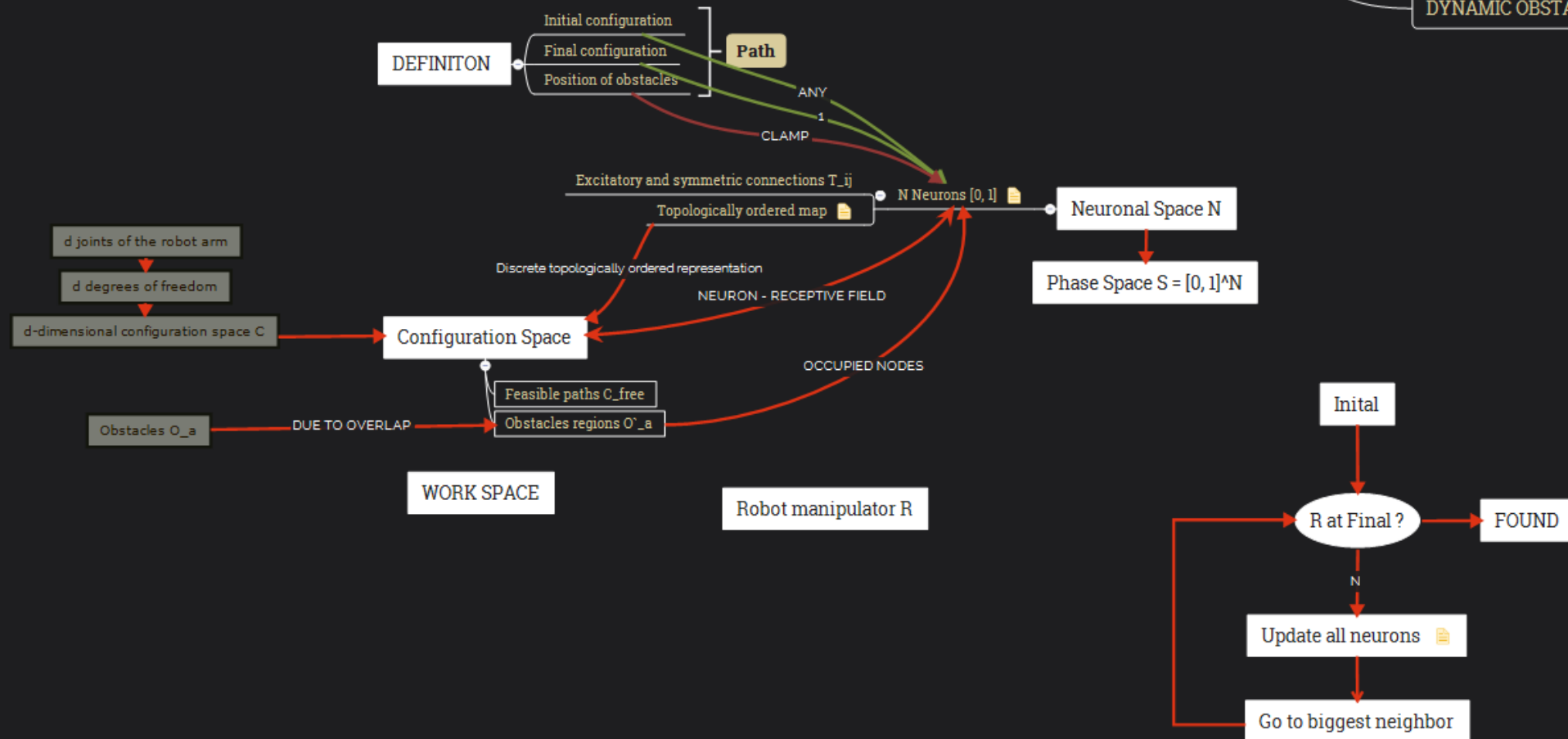
# NEURAL NETWORK DYNAMICS FOR PATH PLANNING AND OBSTACLE AVOIDANCE

- Use Neuronal Space  $N$  to store the geometry information (obstacles)
- The path finding is done from both the initial position and destination
- Can deal with dynamic obstacles
- May be used to deal with unknown area with modifications to the neurons
- A lot of maths - but not intelligent ?

# NEURAL NETWORK DYNAMICS FOR PATH PLANNING AND OBSTACLE AVOIDANCE

NEURAL NETWORK

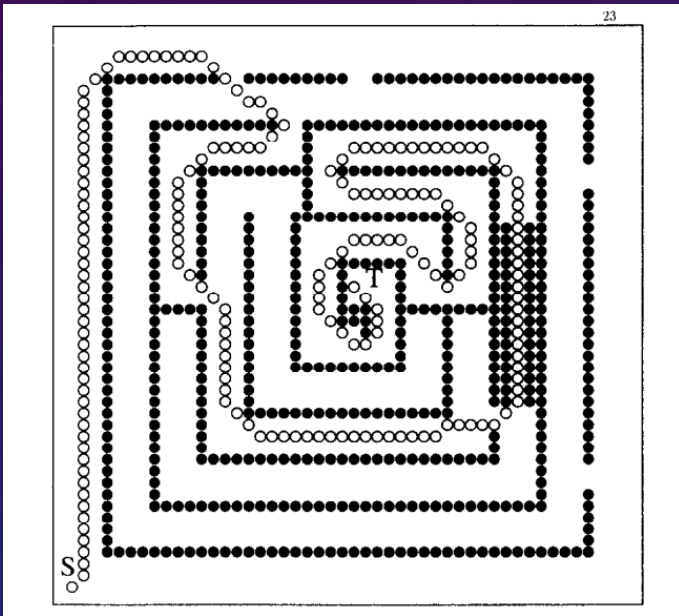
DYNAMIC OBSTACLES





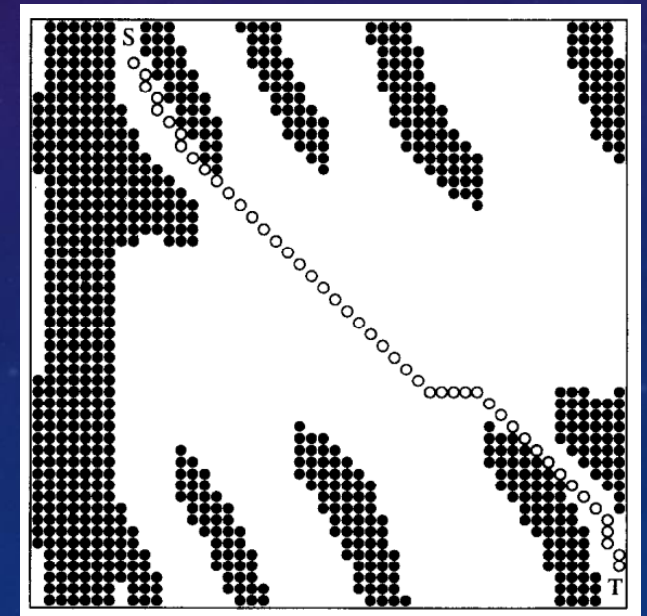
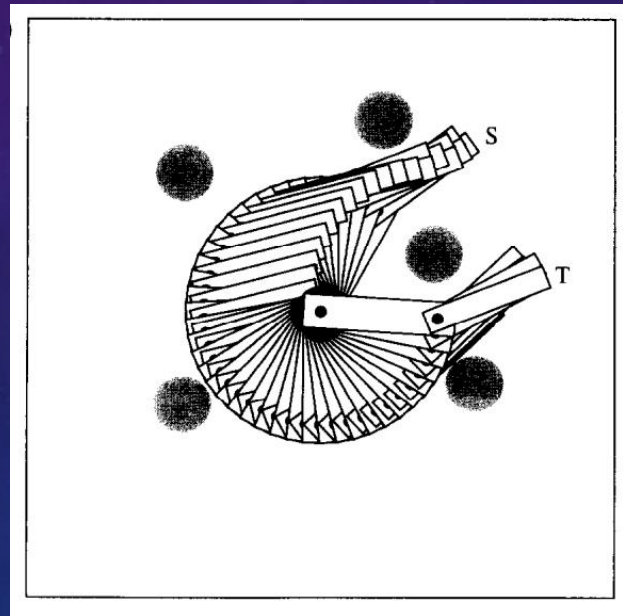
# NEURAL NETWORK DYNAMICS FOR PATH PLANNING AND OBSTACLE AVOIDANCE

Complex as well as dynamic



Shouldn't go randomly at first ?

2D Robot arms (can rotate)



How to generate neuronal space ?

How to quantify arm behavior?

# OBSTACLE AVOIDANCE IN MOBILE ROBOT USING NEURAL NETWORK

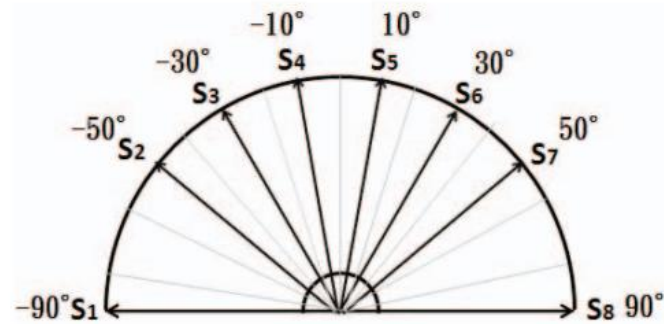
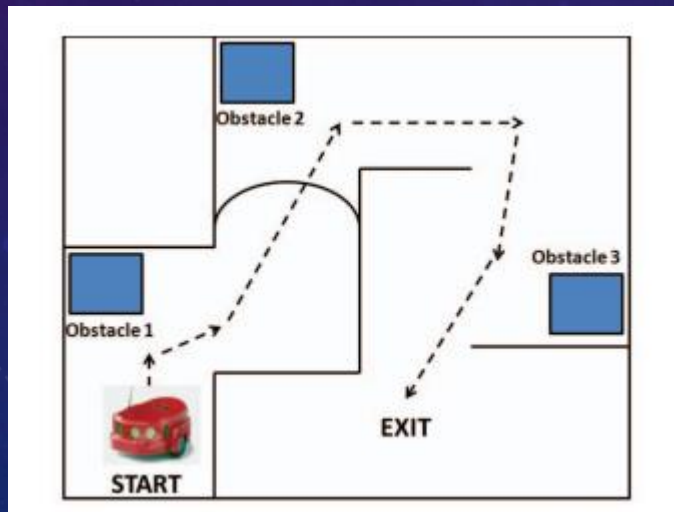


Figure 2. sonar direction and degree in P3DX



- For data training, we construct all obstacle possibilities and define respond of the output.
- Back propagation model (to study)

- Step 1 Initialize weights and thresholds to small random values.
- Step 2 Choose an input-output training data set  $(x(k), t(k))$
- Step 3 Compute NN signals from input to output:

$$O_p^{(l)} = f(\sum_i W_{pi}^{(l)} O_i^{(l-1)}) \quad (1)$$

- Step 4 Compute output error  $E$  and Back propagation parameter at the output layer ( $L$ )

$$\delta_i^{(L)} = [t_i - o_i^L][f'(tot_i^{(L)})] \quad (2)$$

$$E = \frac{1}{2} \sum_{i=1}^n (t_i - o_i^L)^2 + E \quad (3)$$

- Step 5 Update the weights using:

$$\Delta W_{if}^{(l)} = \eta \delta_i^{(l)} o_j^{(l-1)} \quad (4)$$

With Back propagation:

$$\delta_i^{(l-1)} = f'(tot_i^{(l-1)}) \sum_R \delta_p^{(l)} w_{pi}^{(l)} \text{ form } l = L \text{ to } 2 \quad (5)$$

- Step 6 Repeat steps 2-5 for another training data set and compute error.
- Step 7 After using all training data sets (i.e., one epoch), if final error  $E$  is less than a predetermined tolerance. The network has been trained. If not, repeat the process for another epoch.

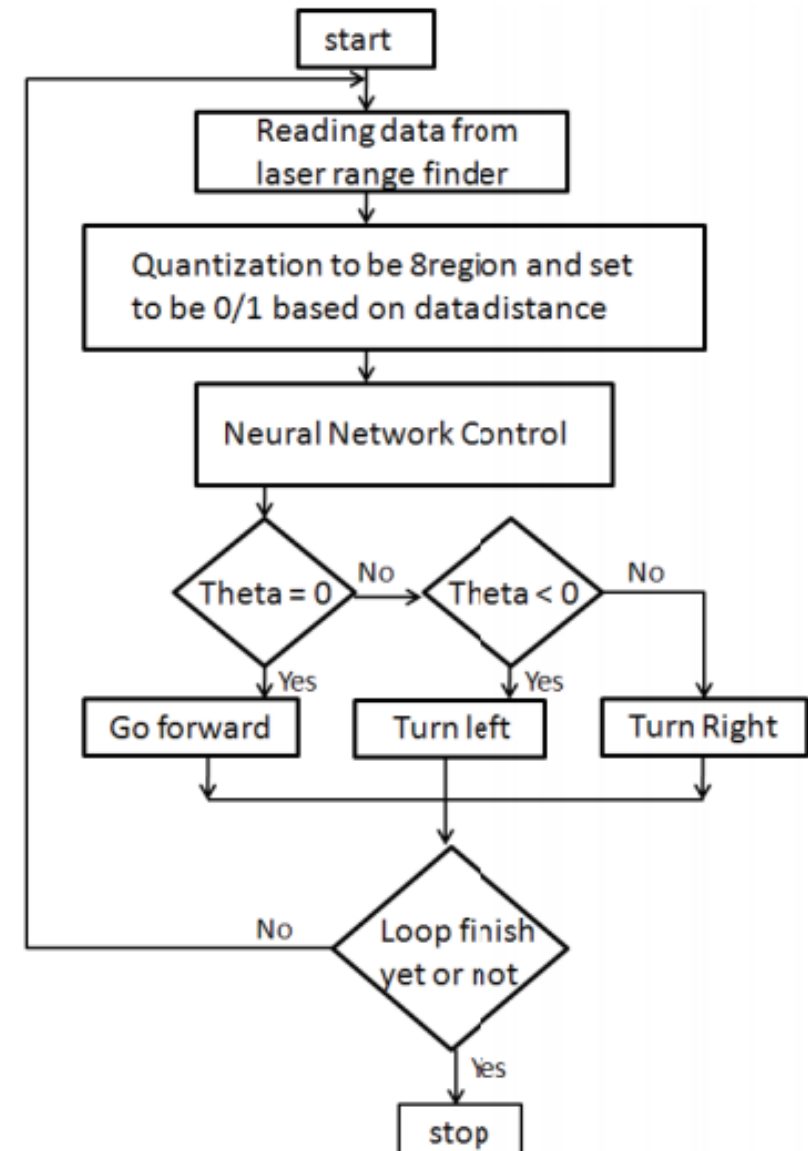
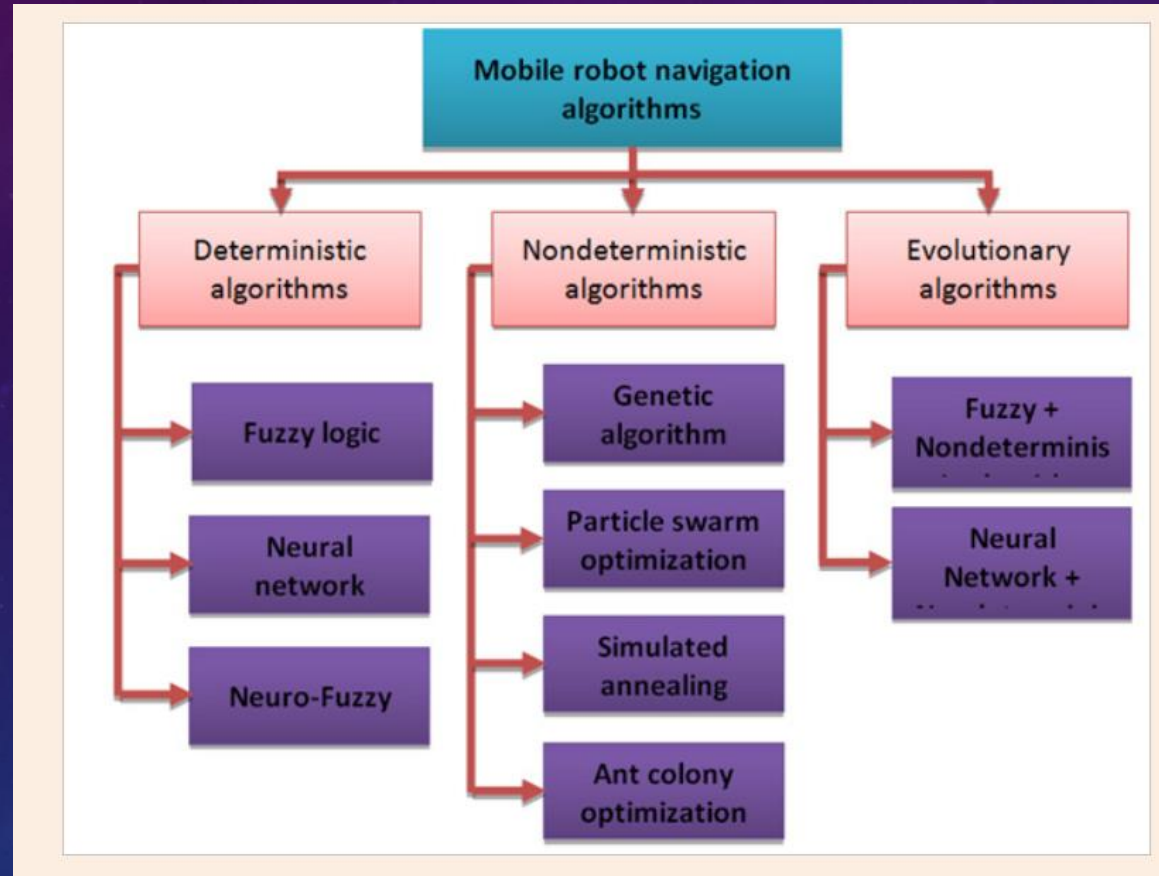


Figure 7. Flow chart of main algorithm structure



# REVIEW



**Mobile Robot Navigation and Obstacle Avoidance Techniques: A Review**