Neural Network Application in Robotics

"Development of Autonomous Aero-Robot and its Applications to Safety and Disaster Prevention with the help of neural network"

Sharique Hayat[1], R. N. Mall[2]

1. M.Tech. Final Year CIM, MMMEC Gorakhpur

2. Asstt. Professor, MMMEC Gorakhpur

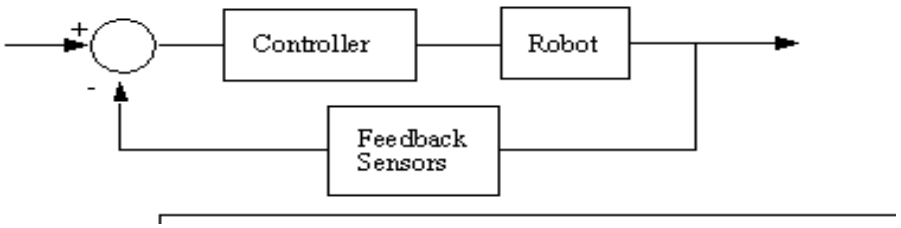
Abstract- To develop an autonomous robot with the application of neural network and to apply it for monitoring and rescue activities in case of natural or manmade disaster and also implementing the neural network in Maruti Udyog Gurgaon for increasing the productivity and more quality improvement of the system.

1.I NTRODUCTION

The term **neural network** is used to refer to a network or circuit of biological neurons. The modern usage of the term often refers to artificial neural networks, which are composed of artificial neurons or nodes

OVERVIEW

A biological neural network is composed of a group or groups of chemically connected or functionally associated neurons. A single neuron may be connected to many other neurons and the total number of neurons and connections in a network may be extensive. Connections, called synapses, are usually formed from axons to dendrites, though dendrodendritic microcircuits and other connections are possible



Use of neural network

Neural networks, with their remarkable ability to derive meaning from complicated data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the

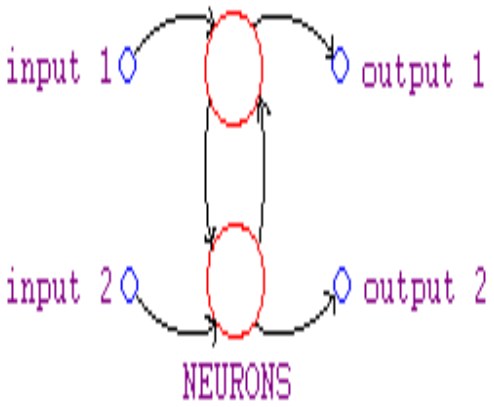
category of information it has been given to analyse. This expert can then be used to provide projections given new situations of interest and answer "what if" questions. Other advantages include:

1. Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.
2. Self-Organisation: An ANN can create its own organisation or representation of the information it receives during learning time.
3. Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.
4. Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.

FUNDAMENTAL DESIGNING OF NEURAL NETWORK

- The design of neural networks and how to use them as a robot brain, simple neural network consisting of only two inputs and two outputs.
- In this diagram there are the inputs 'sensors' and the outputs 'motors'. The relationship between the sensors and the motors can be described in the following table (

- means on and -1 means off). If a sensor is on it means the switch is activated



+1	+1	-1	-1
+1	-1	+1	-1
-1	+1	-1	+1
-1	-1	+1	+1

1.2 HOW TO DESIGN A NEURAL BRAIN

1.Determine what you want the robot to do.

2.Determine the number and types of input you require.

3.Determine the number of outputs you require.

4.Map inputs and outputs to a vector (both must be in the same vector). If it has less inputs and outputs than points in the vector spread them evenly

5.Make a complete set as described in point 4 for all possible combinations of inputs and outputs.

6.Repeat step 5 but this time only put the inputs in the vectors.

7.Now play around with the different variables in neuroqb.zip and try to find the most effective combination

1.3 Developing Autonomous Flight Control Systems for Robot Helicopter by use of Neural Network;

The following areas in the flight system where application of neural network are enable.

Hierarchy structure of Autonomous Flight Control of UAVs top
Situation Awareness
Command Interface middle
Switching Flight Mode

Velocity Control ⇔ Positioning Control etc.
Reconfiguring Flight Control
Fault Detection
Flight Controller bottom

Designing OF Flight Controller

Two methods are important for designing of flight controller;

1. Knowledge of Many Experts
2. Results of Many Experiments

Designing Control Systems for Complex Systems

When there are complex problem comes different methods are implemented;

1. Conventional methods
2. Linearizing of nonlinear dynamics
3. Switching linear controllers
4. Dividing the whole system into some sub-systems
5. Singular Perturbation are required to design control systems

Proposed method

Using neural network training
Treating complex systems directly and in holistic approach

Controller using Neural Network

Ability of neural network
Learning
Training

Off-line Training

Training method based on Gradient
Training method based on Powell's conjugated direction algorithm

On-line Training

Designing and Developing Control Systems

Reconstruction or Reconfiguring Control Systems

1.4 Method to Design Controllers by Use of Neural Networks

Training a neural network

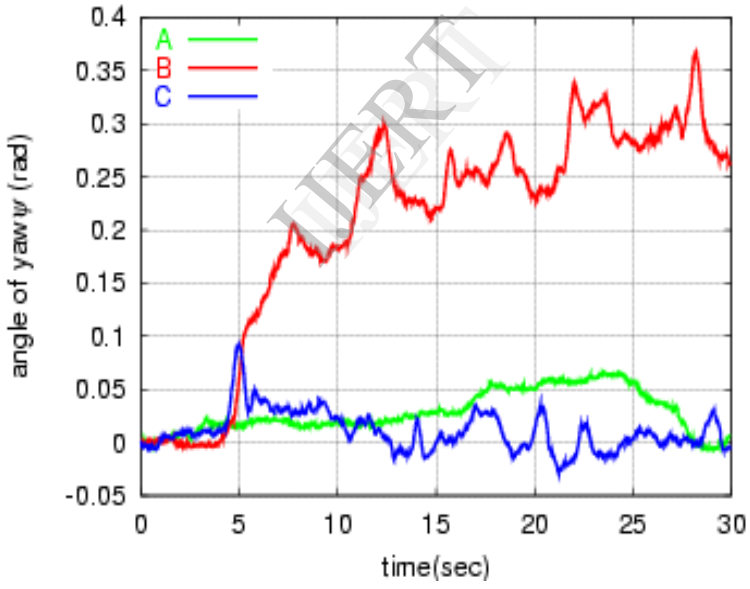
Optimization of a performance index

In developing autonomous flight controller of UAVs, the algorithm enables to use mat lab software.

On-line Training of Neural Network
Indoor Experiment using a small helicopter(electrically powered**)**

Case1.

Under disturbance



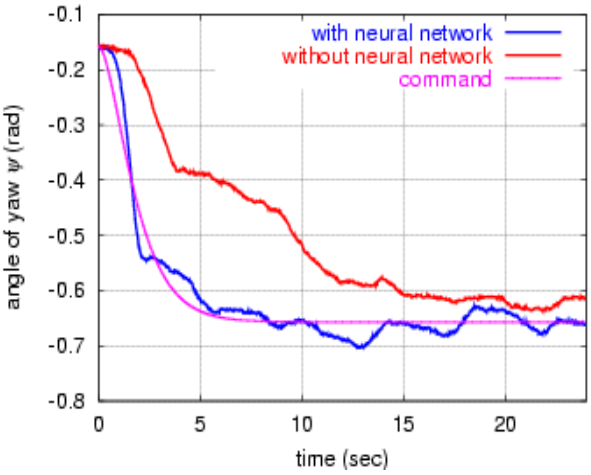
A: without network(No disturbance)

B: without network(witdisturbance)

C: with network(with disturbance)

Case2.

Efficiency of the control is reduced



A:with network

B:without network

For the reliability of the autonomous flight

Numerical Simulations

Inputs of a neural network

Altitude z velocity v_z

Pseudo-Input $U = -K_p(z-d) - K_d v_z$

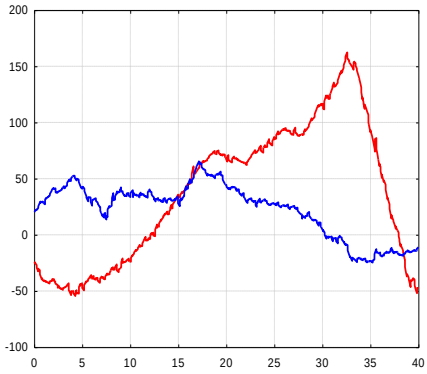
Output of a neural network

Collective control $\delta_{collective}$

Nonlinear dynamics is easily transformed to a linear dynamics

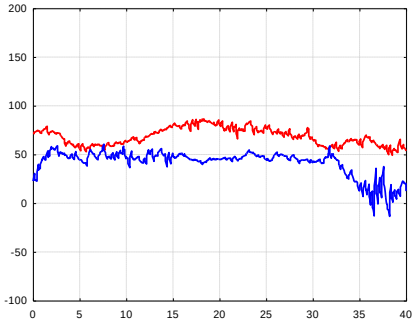
Results of Flight Experiments

Hovering by PD Controller



	E[err] (cm)	Var[err] (cm^2)
without online training	37.8	3832.4
with online training	22.3	554.4

Hovering by Neural Networks



	E[err] (cm)	*Var[err] (cm^2)*
without online training	*68.5*	*77.9*
with online training	*41.6*	*174.5*

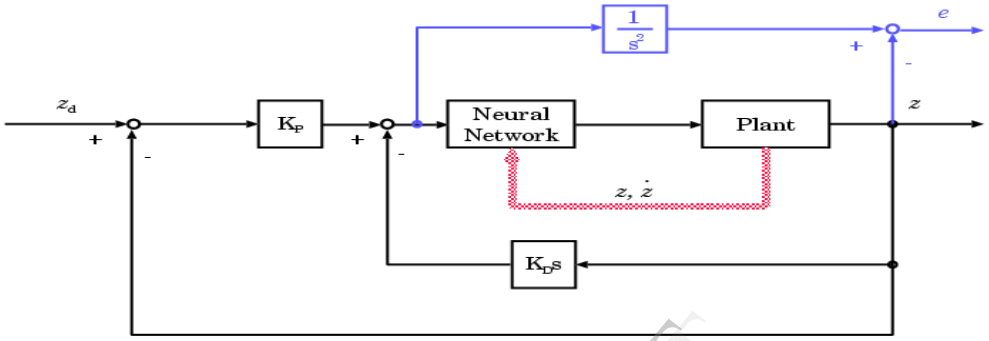
Training Controller for Linearization

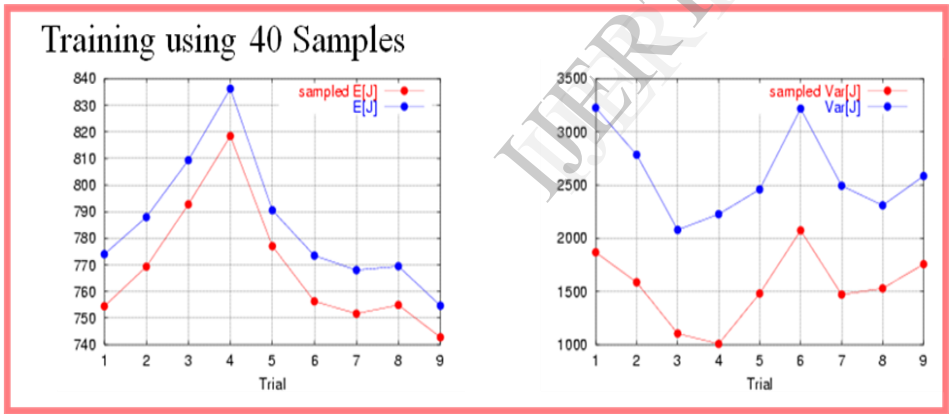
$$U = f(y, \dot{y}, u) = -K_p \cdot (y - d) - K_d \dot{y}$$

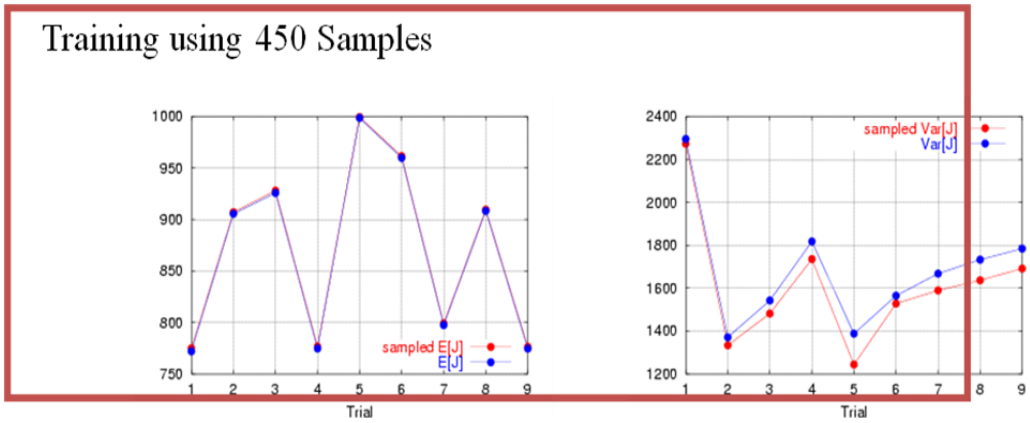
With the help of Hovering and PD Controller method the actual flight position are shows in the graph by red and blue curves and resulted parameters are calculated.

By the analysis it comes out that when the neural network implement in the flight control its become more accurate then the before.

Index for Training







1.5 Applications of neural networks

sales forecasting

industrial process control

customer research

data validation

risk management

target marketing

APPLICATION OF ROBOTS IN ASSEMBLY

The final assembly is still the most labour intensive of all the automobile production shops. The share of the final assembly in total man-hours required for the manufacture of a car is almost 50%. Under the condition, the assembly line becomes most sensitive to labour attitude and productivity. Automation through robot is the universal approach in final assembly operations. However, the robot used in these operations require precise control, that is attained in one of the following two ways:

The control function is embedded in the tools or implements, and the robot works in a play back mode based on comparatively simple message exchange.The robot is provided with pattern recognition through visual and tactile sensors and is made to operate in an intelligent manner.

The robot functions are improved through combination with peripheral tools, and the superiority of robots over human workers is enhanced.

Summary

- Neural Networks have been used in a variety of linear and non-linear controllers.
- Neural networks can handle one or more inputs and outputs.
- Neural networks do not work well when dealing with the mathematical problem of converting space coordinates to joint coordinates.
- Neural networks have been used in most popular control schemes including controlling un modelled processes.
- Various sensors have been used successfully with neural networks.
- Back propagation is the most popular neural network paradigm for robotics research.

Conclusion;

- .The total sheduling time for the manufacturing of car will be reduced and it reduces the number of robots , so that more workstation will be there.
- The application of neural network in robotics to the flight control for monitoring and rescue activities

FUTURE WORK;

- Neural network application are enabled in maruti udyog gurgaon.
- The total sheduling time for the manufacturing of a car will be reduced and it reduces the number of robots , so that more workstation will be there.

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LIST OF FIGURES

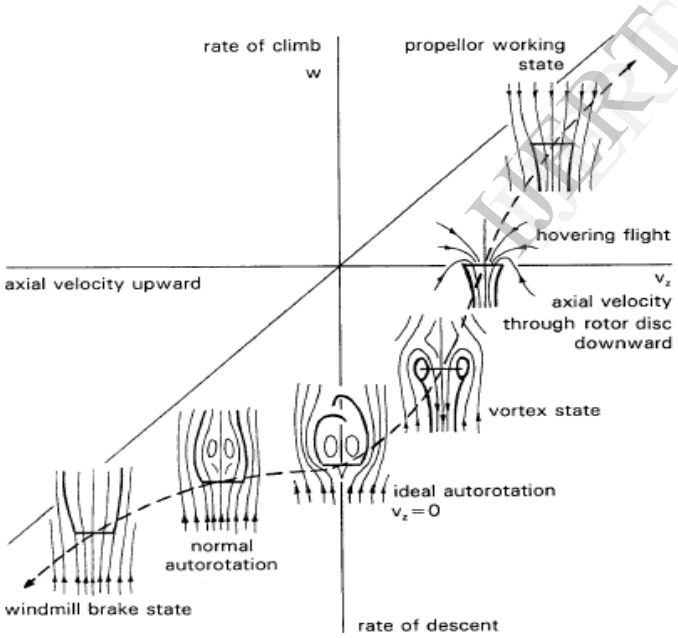

Fig. 2.8 Rotor flow states in axial flight

fig. Manufactuing of Cars in Maruti Udyog Gurgaon

Past and Present SCOPE

The applications of neural network in robotics are following.

- Financial Analysis -- stock predictions .
- Signature Analysis -- the banks in America have taken to NNs to compare signatures with what is stored.
- Process Control Oversight -- NNs are used to advise aircraft pilots of engine problems.
- Direct Marketing -- NNs can monitor results from a test mailing and determine the most successful areas.

Neural network have been used in variety of linear and non linear controllers.it can handle one or more inputs and outputs , neural network have been used in most populer control schemes including controlling un modelled processes .

Implementation of neural network in maruti udyog

- The number of robots are implementing in the maruti udyod plant. Trere are different operations are done by the number of robots in the plant .so by applying the neural network all the operations are done by a single robot.
- By applying the neural network application in the plant the number of robots reduced and the multifunctional task will be done in a single plateform.

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