Using Active Learning in Motor Control and Matlab Simulation

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Abstract—**People's desire to produce systems capable of learning and decision making, has led to the concept of artificial intelligence. One of the many ways that is used in the design of intelligent systems is artificial neural networks. Artificial neural networks are computational networks which attempt to simulate the networks of nerve cell (neurons) like central nervous system of the living. Designing any intelligent control system is possible by modeling. In this paper, solid modeling, and the four axes of motion of a robot arm, the starting point positioning with servo motors of the simulation of neural networks with active learning strategies which types of learning are presented.**

Index Terms—**active learning, artificial neural networks, servo motor**

I. INTRODUCTION

In this study, we would like to bring a novel active machine learning simulation result in order to discuss for which problems the autonomous learning loop can be closed using learning, and to identify the machine learning methods that can be used to close it.

Training phase of learner systems that will be trained with supervised learning is based on input and output data set that produced by this system. Sometimes, training data sets cannot be easily achieved in complex systems by using the system modeling as a result of modeling and control of these systems difficult by using artificial neural networks. In addition, the approach function quality used for the training of the neural network and longer duration of training depending on the size of the training data set also brings out the problems. Active learning has been demonstrated to be successful in reducing the number of training data for tasks as diverse as simple concept learning [1], parameter estimation in Bayesian networks [2], or supervised learning with support vector machines and multi-layer neural networks [3].
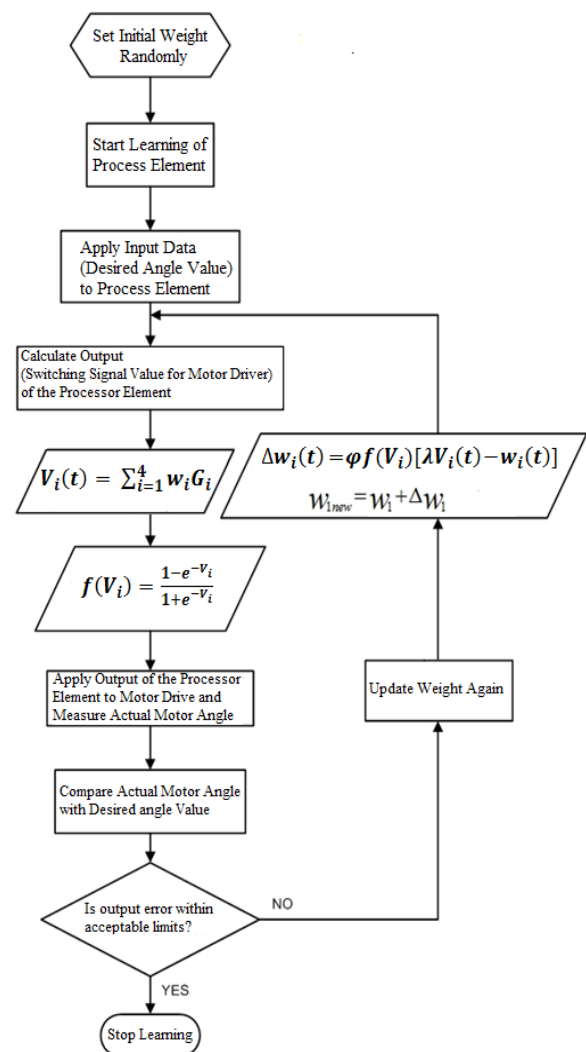
Figure 1. Flowchart for active learning algorithm

In this study, Simulink modeling of a 4-axis robot arm which is motion angles provided by RC servo motors is simulated. Each neuron's input values, the movement points desired to reach the values of the angles in degrees. Produced by neurons in the output values of the starting

points of the RC servo motors connected to the switching signals. Flowchart for active learning algorithm is shown in the Fig. 1. Weight neuron input values (w_i) the active learning algorithm flowchart is changed.

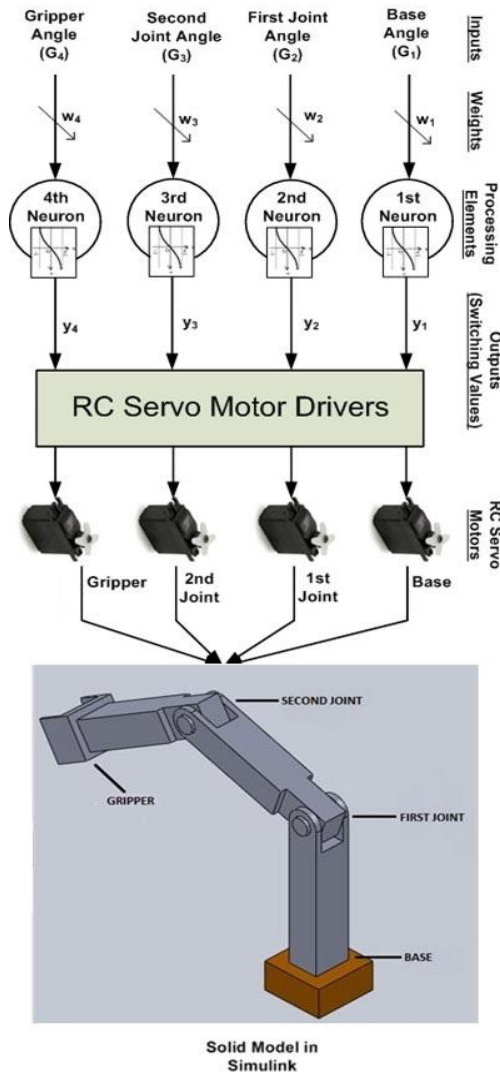The block diagram of the system is given in Fig. 2.

Figure 2. Block diagram of the system

II. APPLICATION

In this study, the application of active learning algorithm, that allows the movement of the joints of a robot arm out of neurons are used to generate control signals of RC servo motors. Three-dimensional solid modeling in SolidWorks software, then the 4-axis robot arm using SimMechanics toolbox in MATLAB / Simulink program and transferred to the MATLAB / Simulink software environment was developed using the Simscape.

A. Solid Model

At this stage, the robot arm solid model created in SolidWorks transferred to Simulink by using SimMechanics plug-in. Performed using SimMechanics plugin physical model in SolidWorks and the SolidWorks assembly robot arm saved as an XML file or a graphic

file format, and then in the SimMechanics software with Simulink for regulation and control is transferred to Simulink.

Simscape blocks, just as you do not have to specify this information when you connect real physical components. The Physical Network approach, with it is through and across variables and nondirectional physical connection, automatically resolves all the traditional issues with variables, directionality, and so on [4], [5], [6].

Fig. 3 shows three-dimensional solid model of the robot arm in Simulink.
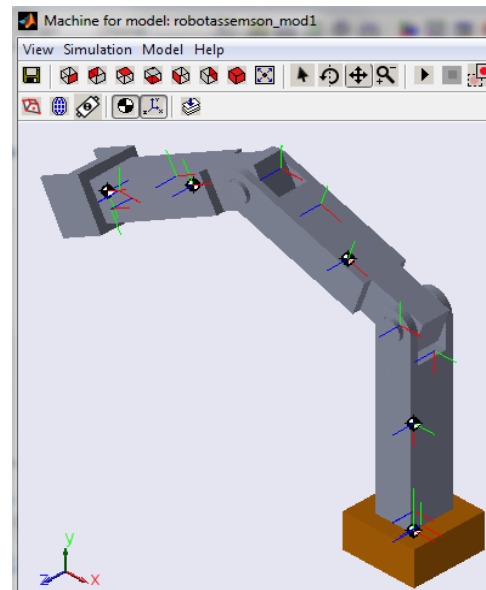

Figure 3. Three-dimensional solid model

B. Interface

Created of Solid modeling and physical model of the robot arm, active learning algorithm with controls to ensure that, MATLAB / GUI interface with the prepared. Active learning algorithm using the GUI interfaces via the programming language MATLAB m-file editor out of written. Fig. 4 shows the designed interface for control of simulation.
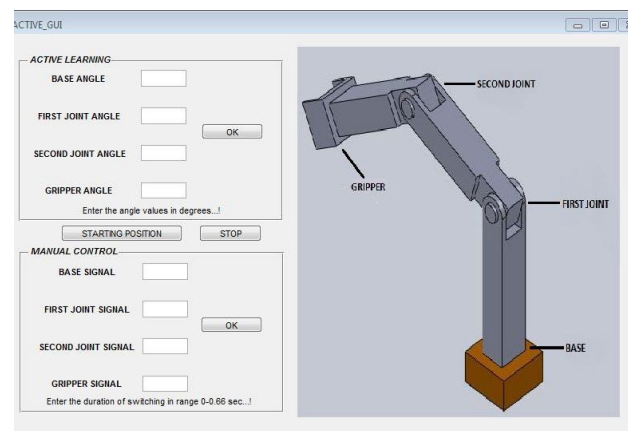

Figure 4. The control interface

In order to obtain 3-dimensional solid model of the system, created the physical model in Simscape is shown in Fig. 5.
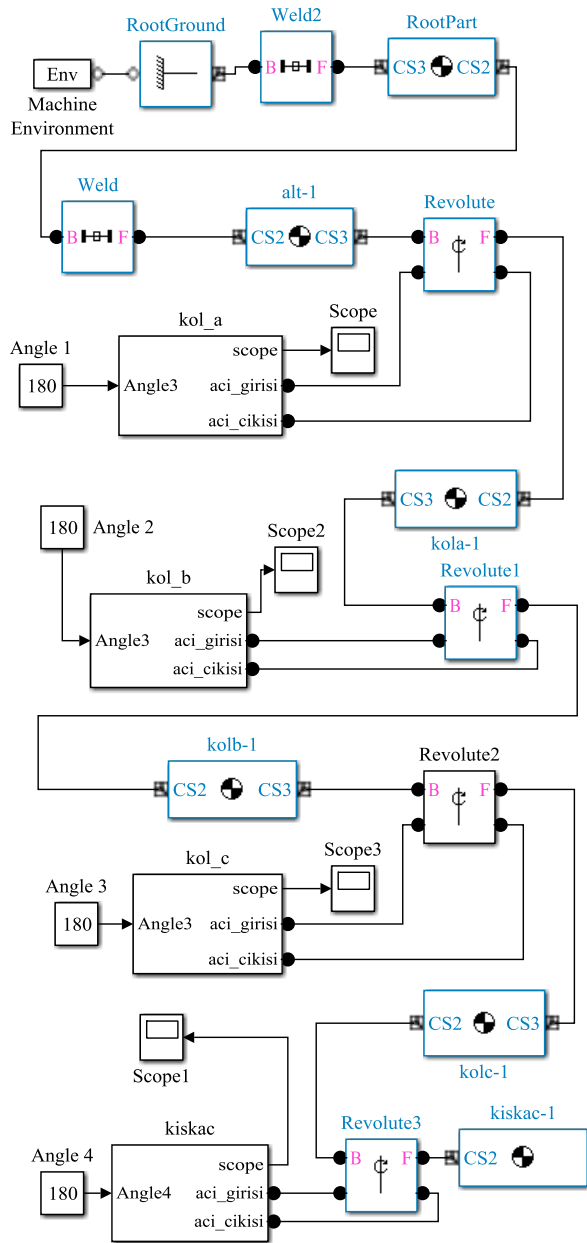
Figure 5.   Physical model

The prepared interface consists of two parts. In this section, input data from each learner neuron must be created. The base angle, first Joint angle, second Joint angle and clamp angle values must be entered in degrees. Angle values are entered, and then click on the OK button. Then these four moves the robot arm should point to come to the desired angle values. To do this, learner neurons in the weight values can be changed with an active learning algorithm. In this way, depending on the starting points of the switching signals produced by RC servo motors and the arrival of the robot arm to the desired position is achieved through learning by doing [7].

MATLAB/Simulink environment-Simscape physically modeled servo motor is used in the simulation. Physical modeling of the servo motor is shown in Fig. 6.

Servo motor control electronics (H-Bridge) is modeled as having a drive shaft connected to the motor shaft. The input signal voltage applied to the switching elements assist, and the by using H-bridge is applied to the servo motor.
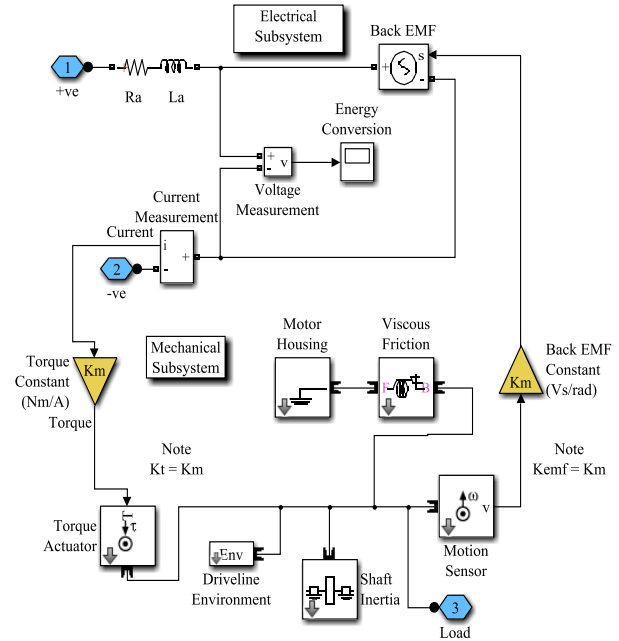

Figure 6.   Servo physical model [6].

The switching signal according to the points of the robot arm joints to be 6.6 seconds with a maximum transmission time for active learning algorithm produced by learner neurons. Any servo motor drive, depending on starting point time of 6.6 seconds with the transmission of a signal is applied, the starting point, which means to be moved 360^0. So according to the desired angle of rotation of the drive signal is applied varies between 0 and 6.6 seconds.

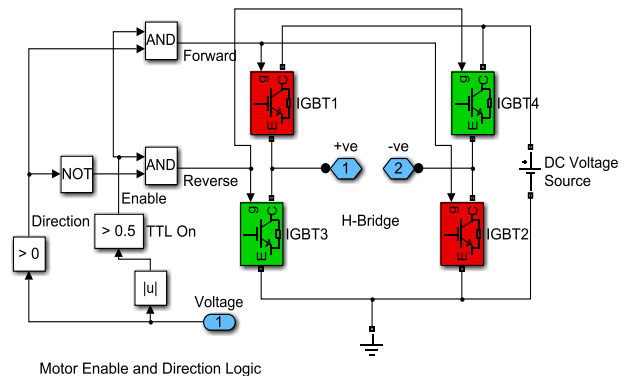The H-Bridge physical model is shown in Fig. 7.

Figure 7.   H-Bridge physical model [6].

MATLAB / Simulink environment-Simscape created the entire physical system model for a single servo motor shown in Fig. 8.
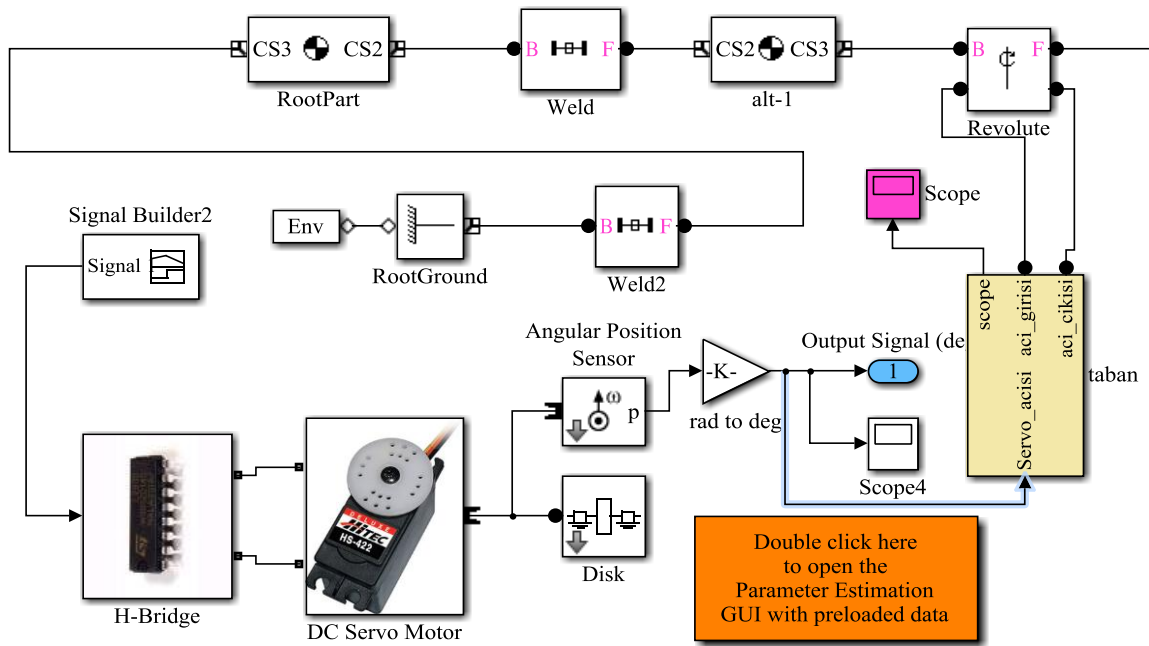
Figure 8.   Full physical model for a single servo motor

III.   SIMULATION RESULTS

Active learning algorithm applied to the model of the entire physical system by using MATLAB/GUI. Base, the first joint, the second joint and clamp positions of the robot arm has been controlled by the RC servo motors. Target angle values of each motion point are entered by using control interface that part of the active learning. Program file is created as a MATLAB/m-file under the user interface that contains the active learning algorithm
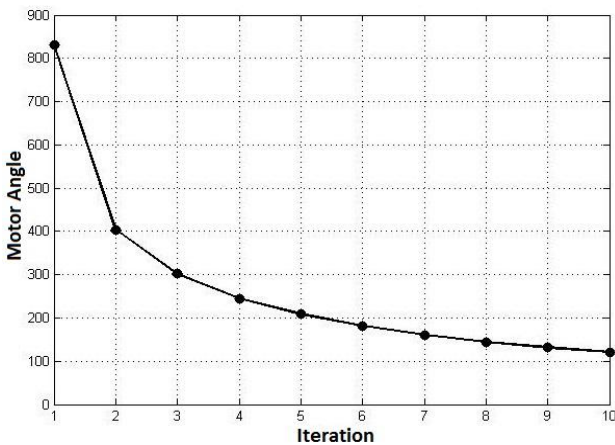

Figure 9.   The iteration-motor angle graph for base servo motor

The data obtained from the number of iterations for the base servo motor, motor angle chart are given in Fig. 9.

The first joint for servo motor, on the number of iterations of the data obtained from the motor angle graph given in Fig. 10.

Joint servo motor from the data obtained from the number of iterations motor angle chart given in Fig. 11.
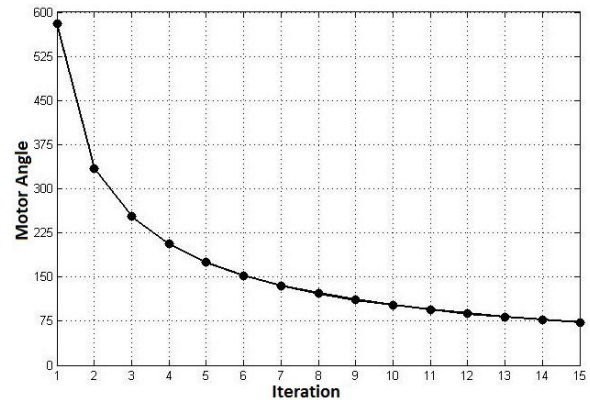

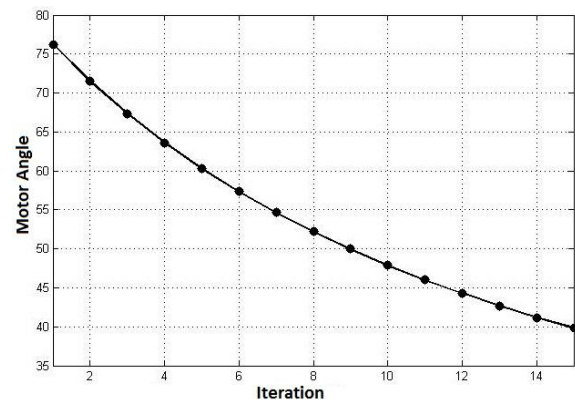Figure 10. The iteration-motor angle graph for the first joint servo motor

Figure 11. The iteration-motor angle graph for the servo motor of the second joint

Motor angle graph which the data obtained from the number of iterations for the clamp servo motor are given in Fig. 12.
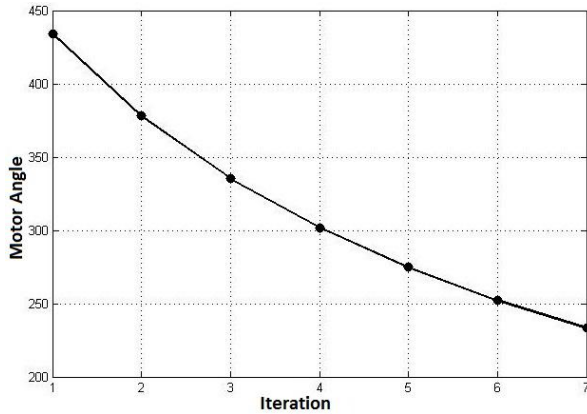
Figure 12. Iteration-motor angle graph for the clamp servo motor

In this study, forgetting factor, $\varphi = 0.05$ and learning coefficient, $\lambda = 0.0027$ was used. These coefficients to show the best performance of learning for learner neurons are finding by various trials.

IV. CONCLUSION

In this study, active learning strategy which types of artificial neural networks learning are used for the RC servo motor control and robotic. Solid modeling in SolidWorks software, then the 4-axis robot arm using SimMechanics toolbox in MATLAB / Simulink program.

In the structure of artificial neural networks, depending on the point of moving the robot arm servo motors four input reference angle values so that the created in four learner neurons. Points of reference angle values entered until the robot arm motion active learning algorithm provided with the connection weight values of each neuron's inputs is replaced.

According to the obtained data from the simulation, the reference angle of 120 degrees for base point for generating the switching signal of neurons as a result of 10 iterations of the learning error has completed approximately 10-degree angle.

The first reference to the joint angle of 75 degrees was entered and the switching signal of about 20 degrees angle error-producing neurons as a result of 15 iterations of the learning cycle.

Entered into a second joint 40 degree angle and point of reference for generating the switching signal of neurons as a result of 15 iterations has completed approximately 10-degree angle error learning.

Clamp the reference angle for 250 degrees, and this point is entered as a result of switching signal generating neurons seventh iteration has completed the learning error of about 20 degrees angle.

Motor control or the control of a robot simulation results obtained from the conventional artificial neural network types as well as active learning strategy, learning by doing, or trying to build a system could be used in learning.

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