

Figure 7: The training state for the proposed N.N.

The best regression is shown in figure (8), where good convergence between outputs and targets were gained through neural network training.

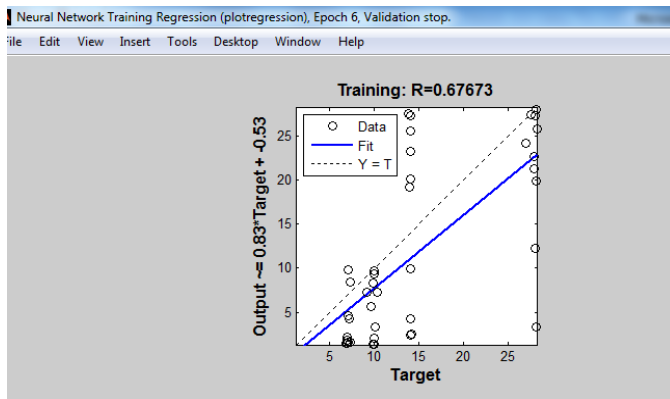


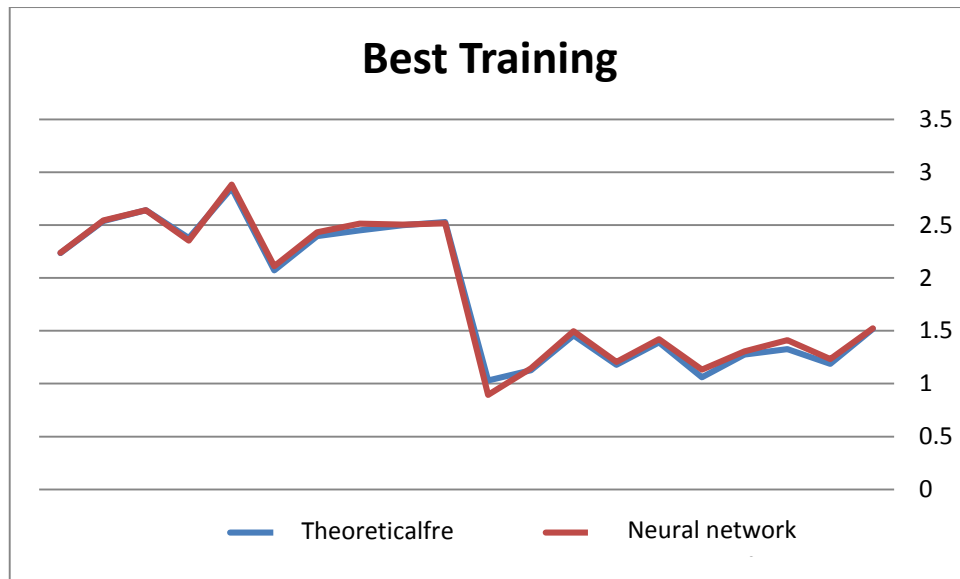
Figure 8: Best Regression for the N.N.

### Neural Network natural frequencies of the robotic link

As the circular natural frequencies of the proposed robotic link were calculated using the Euler Bernoulli theory, those results were considered as targets in THE designing of the neural network, and after training, the outputs which act as the neural network results, these last results would be compared with the theoretical ones that had been found before.

Table 2 : Error Percentage between theoretical and simulated neural network for the first circular natural frequency

No.	Theoretical frequency	Simulation NN frequency	Error Percentage *100%
1	1.524	1.519	0.5
2	1.233	1.188	4.5
3	1.413	1.328	8.5
4	1.306	1.275	3.1
5	1.132	1.059	7.3
6	1.422	1.389	3.3
7	1.205	1.178	2.7
8	1.496	1.457	3.9
9	1.145	1.126	1.9
10	0.893	1.031	-0.138
11	2.517	2.528	-1.1
12	2.504	2.499	0.5
13	2.514	2.449	6.5
14	2.433	2.395	3.8
15	2.111	2.072	3.9
16	2.883	2.849	3.4
17	2.354	2.377	-2.3
18	2.642	2.640	0.2
19	2.543	2.537	0.6
20	2.238	2.236	0.2



**Figure 9:** Comparison between theoretical and N.N frequencies.

A very acceptable error percentage was noticed between theoretical and neural network results of the first circular natural frequency as shown in figure (9), and this is right also for each of the second, third, and fourth circular natural frequencies.

## CONCLUSION

In this study, a model of a robotic link is presented to be analyzed for its free vibration response and get its natural frequencies, firstly adapting the traditional Euler – Bernoulli method, and secondly simulating one of the artificial intelligence method which is neural network method.

The proposed ANN was noticed to be trained in a good manner and acceptable solutions were achieved, the differences between actual and predicted target values using this neural network show that reasonable values of error were gained, So, the free vibration natural frequencies' results showed the usefulness and effectiveness of the proposed neural network, where less computing time and cost were reached besides taking the recent trend of using artificial intelligence methods to replace the classical ones. For the purpose of the another work part will be important which is the experimental part, by building the robotic arm from different materials and different physical properties to get natural frequencies' results.

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