Table 4
Rating Score for each type of controller during disturbance for the real power P_2

	Rise Time (Sec.)	Settling Time (Sec.) (2%)	Overshoot (%)
NNMPC	1.11	2.26	19.2
NARAMA	1.15	2.31	19.4

6 Conclusion

The capability of controlling the system parameters in the transmission lines which consist of UPFC was verified and found that the steady state and dynamic behaviour of the power system was enhanced in presences of the UPFC and the adaptive controllers. The robustness, controllability and the effectiveness of the proposed adaptive controllers (NARMA-L2) has been proven. In addition, the proposed controller can perform faster in terms of rising time and settling time than the NNMPC. However, the overshoot percentage created with using NARMA-L2 controller is greater than NNMPC during sudden step change and sudden system disturbance.

Refrences:

[1] M. M. Mijwel, Pattern Recognition and Neural Networks.[online]. Available:*https://www.researchgate.net/publication/322632189_Pattern_Recognition_and_Neural_Networks.*2017.

[2] R. Hill, G. Wyse and M. Anderson, *Animal physiology*, 1st ed., Sunderland, *MA: Sinauer Associates, Inc*, 2004.

[3] L. Gyugyi, "Unified power flow control concept for flexible AC transmission systems ", *IEE proceedings c (generation, transmission and distribution)*, vol. 3, pp. 323-331, 1992.

[4] A. Nabavi-Niaki and M. R. Iravani, "Steady-state and dynamic models of unified power flow controller (UPFC) for power system studies", *Presented at 1996 IEEE iPES Winter Meeting, Baltimore*, pp. 447-454, 1996.

[5] M. Abido, "Analysis and assessment of statcom-based damping stabilizers for power system stability enhancement", *Electric Power Systems Research*.; vol. 73, ch.2, pp. 177–185, 2005.

[6] M. Abido, A. Al-Awami and Y. Abdel-Magid, "Analysis and design of upfc damping stabilizers for power system stability enhancement", IEEE International Symposium on Industrial *Electronics*, vol. 3, pp. 2040–2045, 2006.

[7] F. Garces, V. Becerra, C. Kambhampati, and K. Warwick, *Strategies for Feedback Linearisation: A dynamic neural network approach*, 1st ed., London: Springer Science & Business Media, 2003.

[8] A. Awwad, H. Abu Rub and H. A. Toliyat, "Nonlinear autoregressive moving average (NARMA-L2) controller for advanced ac motor control", *IEEE 34th Annual Conference of Industrial Electronics (IECON)*, pp. 1287–1292, 2008, DOI: 10.1109/IECON.2008.4758140.

[9] S. S. Mokri, H. Husain and A. Shafie, "Real time implementation of NARMA L2 feedback linearization and smoothed NARMA L2 controls of a single link manipulator", *American Journal of Applied Sciences*, vol. 5, ch. 12, pp. 1942-1649, 2008.

[10] H. Demuth, M. Beale and M. Hagan, *Neural network toolbox™ user's guide*, 6th ed., Natick, MA: The MathWorks, Inc., 2009.

[11] K. S. Narendra and S. Mukhopadhyay, "Adaptive control using neural networks and approximate models". *IEEE Transactions on Neural Networks*, vol. 8, ch. 3, pp. 475−485, 1997.