CONCLUSION

This paper includes two different techniques to design a stable controller for a non-linear system i.e. single link flexible robotic arm. The problem faced in the sliding mode was chattering, so the results are compared with twisted controllers but it takes more time to stabilize. So both controllers have advantage and disadvantage. So it will be correct to say that user can select controller regarding to there need. The results are obtained through simulation.

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REFERENCES

- [1] L. Tian and C. Collins, "Adaptive neuro-fuzzy control of a flexible manipulator," *Mechatronics*, vol. 15, no. 10 december 2015, p. 1305–1320, 2005.
- [2] Spurgeon and sarah, "Sliding mode control," European Control Conference (ECC), 2014.
- [3] M. T. Rodríguez and S. P. Banks, "Sliding Mode Control for Nonlinear Systems," *Linear, Time-varying Approximations to Nonlinear Dynamical Systems*, Springers, pp. 123-139.
- [4] A. H. Aryanfar, M. R. Khammar and F. Piltan, "Design a robust self-tuning fuzzy sliding mode control for second order systems," *International Journal of Engineering Sciences Research-IJESR*, Vol. 03, pp. 711-717, 2012.
- [5] Dupic, Mihaj and N. Siamak, "Dynamic modelling and simulation of a rotating single link flexible robotic manipulator subject to quick stops," *journal of mechanical engineering*, 2014, 2014.
- [6] S. Erkaya, S. Su and I. Uzmay, "Dynamic analysis of a slider-crank mechanism with eccentric connector and planetary gears," *Mechanism and Machine Theory*, Vol. 4 No. 4, pp. 393-408, 2007.
- [7] S. B. Choi and J. W. Cheon, "Vibration control of a single-link flexible arm subjected to disturbances," *Journal of sound and vibration*, pp. 1147-1156, 2004.
- [8] A. Sanza and V. Etxebarriaa, "Experimental control of a single-link flexible robot arm using energy shaping," *International Journal of Systems Science*, Vol. 38, 2007.
- [9] M. R. Rokui, "Experimental results on discrete-time nonlinear adaptive tracking control of a flexible-link manipulator," *IEEE Transactions on Systems Man and Cybernetics Part B (Cybernetics)*, 2000.
- [10] A. C Haung and K. C. Liao, "Mechanical Engineering Department, National Taiwan University of Science and Technology," *Journal of Sound and Vibration*, pp. 194-2005, 2006.
- [11] H. Y. Park, "Eigen vectors assignment based vibration suppression control for a two link flexible joint robot arm," *international conference on control Automation and Systems*, 2008.
- [12] M. Sonia, F. Manif and N. Derbel, "Second order sliding mode control applied to inverted pendulum," 14th international conference on science and techniques of automatic control & computer engineering, 2013.
- [13] R. M. Hirschorn, "Stabilization of single input non linear systems using higher order compensating sliding mode control," proceedings of 44th IEEE conference on Decision and Control, 2005.

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