modelling structure. Therefore, it should be remembered that proposed control-oriented LFT modeling approaches are capable of ensuring robust stability and performance, that, in turn, makes it more versatile and acceptable than any other application-oriented modeling approaches.

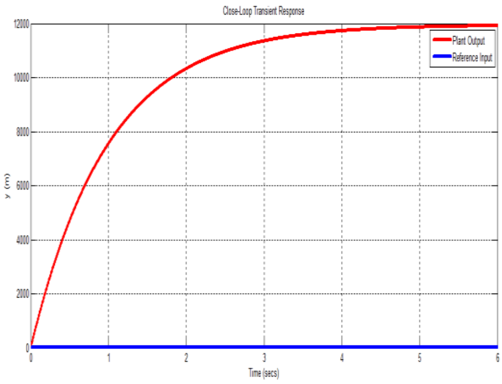

Figure 14. Open loop transient response of the perturbed BLDC motor

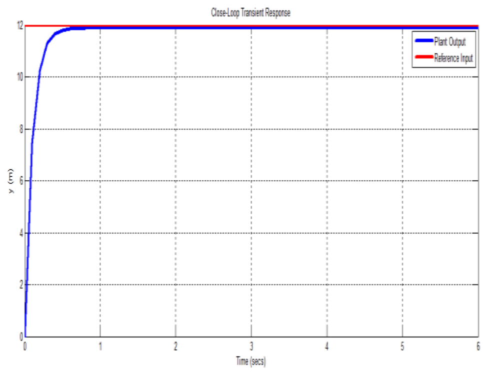

Figure 15. Closed-loop transient response of the system with H_∞ controller

5. CONCLUSIONS

This paper presents a control oriented LFT modeling framework for the n^{th} order linear dynamical system. At the outset of the modeling, parametric uncertainties have been introducing to transform the generalized transfer function of the linear dynamical system into a comprehensive model consisting of the nominal system model and transfer function matrix to account for the various model uncertainties to represent the system model in LFT framework. The proposed modeling algorithm is essential for the application of the modern robust control technique like μ-analysis and synthesis in addition to H_∞ -Control and H_∞-Loop Shaping in order to obtain optimal control performance. The uncertain physical parameters are not known precisely and it is assumed that the parameter values are known within an interval to express in terms of possible relative error. The LFT modeling realization of a dynamical system is a minimal representation refers to the smallest possible dimension of the uncertainty matrix. The model of dynamical systems varies due to changes in the system configuration and the operating conditions. This system variable characterized as model uncertainties to facilitate and improve the effect that incorporates in the system modeling to improve the model quality, increase the system reliability and better utilization of appropriate control law.

The effectiveness of the proposed modeling algorithm has been verified on a BLDC motor to validate the feasibility of the modeling technique. This mathematical framework permits the desired accuracy of the proposed modeling structure based on the availability of reliable model parameter values and establishes the fact that the generalized modeling algorithm is suitable for real-time applications. H_∞ control law has been implemented to the upper LFT structure of the BLDC motor and it has been observed that the closed loop system achieves the robust stability as well as robust performance even in the presence of all parametric uncertainties and disturbances. Moreover, closed loop system exhibits satisfactory transient response in time domain analysis. Finally, it has been observed that the generalized H_∞ control-oriented modeling technique is a very convenient and quite effective approach for robust control law.

REFERENCES

[1] Mary AD, Mathew AT, Jacob J. (2013). A robust H-infinity control approach of uncertain tractor trailer system. IETE Journal of Research 59(1): 38-47. https://doi.org/10.4103/0377-2063.110626

[2] Giarre L, Milanese M. (1997). H_∞ identification and model quality evaluation. IEEE Transaction on Automation Control 42(2): 188-199. https://doi.org/10.1109/9.554399

[3] Casella F, Lovera M. (2008). LPV/LFT modeling and identification: Overview, synergies and a case stud. Symposium on Computer-Aided Control System Design, 852-857. https://doi.org/10.1109/CACSD.2008.4627358

[4] Marcos A, Bates DG, Postlethwaite I. (2005). Exact nonlinear modelling using symbolic linear fractional transformation. 16th IFAC World Congress 16(1): 31-36. https://doi.org/10.3182/20050703-6-CZ-1902.00032

[5] Zhou K, Doyle JC. (1998). Essentials of Robust Control. New Jersey: Prentice-Hall.

[6] Conway R, Felix S, Horowitz R. (2007). Parametric uncertainty identification and reduction for robust H_2 synthesis for track- following in dual-stage hard disk drives. American Control Conf., 68-75. https://doi.org/10.1109/ACC.2007.4282569

[7] Cheng Y, Moor BD. (1993). A multidimensional realization algorithm for parametric uncertainty modeling problems. 32rd IEEE Conf. on Decision and Control, 3022-3023. https://doi.org/10.1109/CDC.1993.325755

[8] Hecker S, Varga A. (2004). Generalized LFT- based representation of parametric uncertain models. European Journal of Control 10(4): 326-337. https://doi.org/10.3166/ejc.10.326-337

[9] Gu WD, Petkov PH, Konstantinov MM. (2005). Robust Control Design with MATLAB. 1st ed., Springer, Germany.

[10] Oguntoyinbo OJ. (2009). PID control of Brushless DC moor and robot trajectory planning simulation with MATLAB/SIMULINK', M. Tech. diss. Vaasan Ammatikorkeakoulu University of Applied Sciences.

[11] Paw YC, Balas GJ. (2008). Parametric uncertainty modeling for LFT model realization. IEEE International Conference on Computer-Aided Control System Design, San Antonio, 834-839. https://doi.org/10.1109/CACSD.2008.4627338