

Dual-drive gantry stage decoupling control based on a coupling model

Julien GOMAND, Xavier KESTELYN, Richard BEAREE and P.-J. BARRE

Laboratory of Electrical Engineering and Power electronics of Lille, ENSAM Lille, France

Tel: +33(0)320 622 238 – Fax: +33(0)320 622 750 – e-mail: xavier.kestelyn@lille.ensam.fr

Abstract: A Dual-Drive Moving Gantry Stage Robot can be modelled as a square MIMO system. However, it is usually considered as two independent SISO systems: classical industrial gantry control is achieved by two independent position controllers. This control structure does not take into account the mechanical coupling between the two actuators and leads to a reduction of the overall performances of the system. In this paper, a physical lumped parameters model of an industrial robot is proposed and experimentally identified. It is based on a structural, modal, and Finite Element Method analysis. Then, a physical model-based control structure is deduced. The solution is finally simulated and implemented on an experimental test bench. Results are compared to the performances of the initial industrial control and show an improvement of the overall performances.

Keywords: Dual-drive gantry robot, Mechatronics, Physical modelling, Decoupling motion control.

Acknowledgement

This work has been supported by Ralph Coleman of ETEL's Motion Control Research Team who works actively with the L2EP (Laboratory of Electrical Engineering and Power electronics) of Lille, France.

References

- [1] <http://www.etel.ch>
- [2] Heung-Keun Park, Sung-Su Kim, Jin-Moo Park, Tae-Yeon Cho, Daehie Hong, "Dynamics of dual-drive servo mechanism", IEEE International Symposium on Industrial Electronics 2001, Proceedings. ISIE 2001, vol. 3, pp. 1996-2000, June 2001.
- [3] Teo C.S., Tan K.K., Huang S., Lim S.Y, "Dynamic modeling and adaptive control of a multi-axial gantry stage", IEEE International Conference on Systems, Man and Cybernetics, 2005, vol. 4, pp. 3374-3379, Oct. 2005.
- [4] Sungsoo Kim, Baeksuk Chu, Daehie Hong, Heung-Keun Park, Jin-Moo Park, Tae-Yeon Cho, "Synchronizing Dual-Drive Gantry of Chip Mounter with LQR Approach", Proceeding of the 2003 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2003).
- [5] Yu Dongmei, Guo Qingding, Hu Qing, "Study on synchronous drive technique of biaxial linear servo motor based on decoupling control and internal model control with two-degree-of-freedom", Sixth International Conference on Electrical Machines and Systems, 2003, ICEMS 2003 Proceedings, vol. 2, pp. 541-543, Nov. 2003.
- [6] R. Béarée, J-P. Hautier, P-J. Barre "Control structure synthesis for electromechanical systems based on the concept of inverse model using Causal Ordering Graph", IEEE-IECON'06, Paris, November 2006.
- [7] M. Mathia, V. Very, "Method for analysing a drive system", ETEL patent EP 1 467 266 B1, September 2006