

200N Moving Iron Actuator, for high dynamics, and high efficiency, industrial applications.

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RESUME - CEDRAT TECHNOLOGIES is designing a product range of innovative linear magnetic actuators called MICA (Moving Iron Controllable Actuator). Such actuators present many advantages in the field of high dynamics, and high efficiency applications, such as anti-vibration and chatter reduction during thin work-pieces machining processes. This paper presents the MICA200M, which has been implemented on the machining process of turbine casings, in the frame of the ICT FoF FP7 European project INTEFIX. This actuator has been designed for a 200N linear force versus current, and the performances of the complete actuator system, including the CSA96 MICA drive electronic, has been fully demonstrated.

Mots-clés — Actuator, Magnetic, MICA, Moving Iron, High Bandwidth, Current Switching Amplifier

1. INTRODUCTION

The ICT FoF FP7 European project INTEFIX requires high dynamics linear actuator suitable for anti-vibration applications like the chatter reduction for the turning of thin work-pieces of turbine casing. In the frame of this project, Cedrat Technologies has designed a new innovative Moving Iron Controllable Actuator (MICA). The paper presents in a first part the application goals and the main particularities of MICA200M magnetic actuator. Then, results of complete experimental characterisation are detailed. Finally, a comparison analysis is done with existing voice coil actuators and the article concludes on the benefits of MICA200M.

2. INTEFIX PROJECT AND ACTUATION NEEDS

The INTEFIX project aims at improving the machining of thin work-pieces thanks to the use of intelligent fixture which includes the reduction of vibration, the compensation of constraints relaxation and the accurate positioning of work-pieces. The study case described here is the reduction of chatter vibration during the turning of a turbine casing work-piece shown in Fig. 1[1]. The reduction of vibration is performed with the help of active systems embedded on the work-piece support which rotates during the turning. The actuation needs to be compact, generate high forces and includes electrical power supply with anti vibration control.



Fig.1 Turbine casing work-piece

3. LAST INNOVATION WITH MICA ACTUATORS SERIES

A special version of the MICA series has been developed to meet the application specifications. Several innovations have been integrated so that this actuator has the highest bandwidth within the MICA series [2][3]. This includes smoother linearity, higher mechanical stiffness, easier assembling, more robust elastic guiding, better thermal dissipation and higher acceleration (up to 100G). The improvements will be further discussed.

4. PROTOYPES AND RESULTS

Main characteristic of MICA200M (See Fig. 2) are presented including dimensions, forces, stroke, bandwidth and main adapted applications.



Fig.2 CSA96 and MICA200M prototypes

Additionally to the necessary compactness for embedded system, specifications include a medium force of $\pm 200\text{N}$ linear versus current, thus independent from plunger position $\pm 2.5\text{mm}$. Measurement results of force versus position and current will be presented. The acceleration performances will be given.

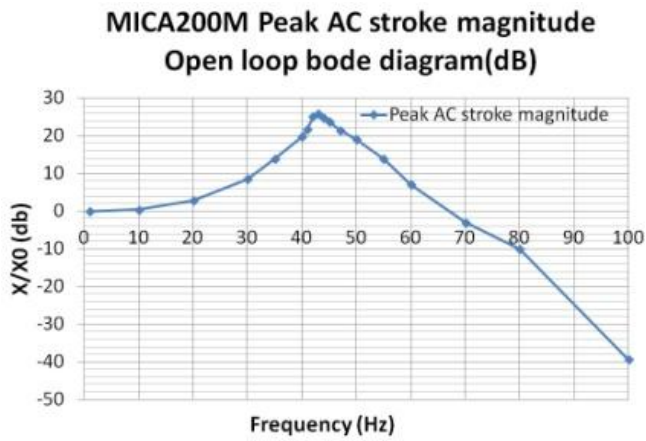


Fig.3 MICA200M open loop Bode diagram

Reduction of vibration on large bandwidth requires high dynamicity of the actuator. Measurement of the actuation bandwidth (see Fig. 3) for alternative actuation up to 200Hz will be performed and commented. The measured response time for 5mm step stroke will also be analysed (Preliminary in Fig. 4).

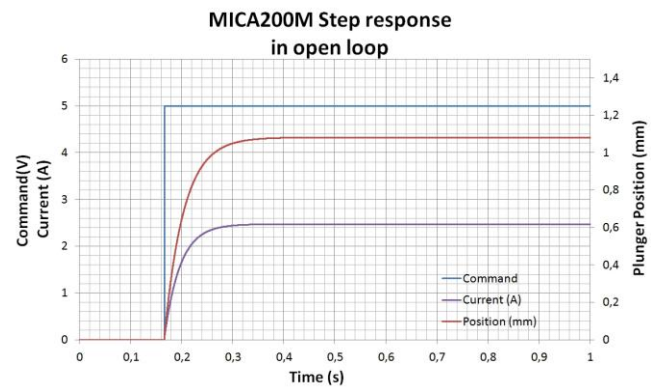


Fig.4 MICA200M open loop measured step response

5. CONCLUSIONS

MICA200M measured performances are compared to commercialised voice coil actuators. The specificities of the new actuator will be presented and markets for which it is recommended will be identified.

6. REFERENCES

- [1] H.C. Möhring, P. Wiederkehr, "Intelligent fixture for high performances machining", 7th HPC 2016, CIRP Conference on High performance cutting.
- [2] P. Meneroud, T. Porchez, J. Muñoa, S. Rowe, A. Pages, C. Benoit, C. Belly "Moving Iron Controllable actuator : Performances in closed loop", Proc. ACTUATOR 14, 14th international conference on new actuators, 23-25 June 2014, P26, pp. 530 – 533
- [3] P. Meneroud, C. Benoit, T. Porchez, F. Claeysen, "MICA Actuator: Highly dynamic controllable", Proc. ACTUATOR 2012, 13th international conference on new actuators, 18-20 June 2012, P33,