Actuator/Sensor Integration in Magnetic Bearings

Zdzisław GOSIEWSKI
Aviation Institute, Military University of Technology
Warsaw, Poland, gosiewski@wmt.wat.edu.pl,

Marcin SZARO
Aviation Institute, Military University of Technology
Warsaw, Poland, *szaro@wmt.wat.edu.pl*

ABSTRACT

Eddy currents sensors are generally applied in magnetic bearings for non-contact measurement of rotor displacement. They have disadvantages: they are relatively expensive; they require calculation of offset; usually they are not collocated with actuator; system reliability is deteriorated.

For these reasons, we are looking for other solutions of rotor displacement measurement. In the paper we propose an inductive sensor with a high frequency RLC resonant circuit with coils of magnetic bearings as a part of measuring components. It leads to the collocation of sensors and actuators and reduces the number of sensor/actuator components. Finally, the system reliability increases. For measurement purposes we used the classical control circuit of magnetic bearings with analog amplifiers.

Also, for measurement purposes an external capacitor is added to one of serially joined coils of the magnetic bearing. Voltage from the capacitor is demodulated. Signal value depends only on dislocation of rotor from neutral (magnetic bearing centre) position. In the paper, we describe mathematical model of inductive sensor system. This model was simulated in Matlab-Simulink environment. There are shown simulation characteristics of measurement circuit of sensor.

A prototype of measurement system was tested on the lab stand. We present static and dynamics characteristics, particularly static linear characteristics and step responses.

In our investigation on sensor and actuator integration we proved possibility of control magnetic bearing without additional sensor, e.g. eddy currents sensor. RLC sensor have linear static characteristic near operation point. It has also great sensitivity similar to eddy currents sensor. The bandwidth depends on frequency of supply voltage. When we use high frequency, the bandwidth would be higher, but we would have to take into consideration effects similar like in eddy currents sensor. In our model of inductive sensor we have checked (as far as it was possible in our lab stand) the band is linear to frequency 300 [Hz]. In future researches we'll have to work out method auto diagnostic of sensor.