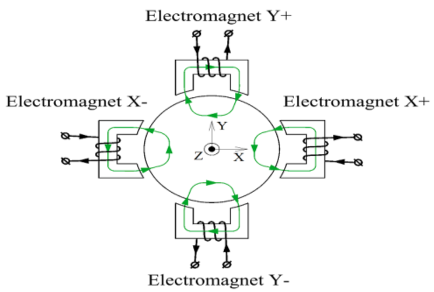
# ACTIVE MAGNET BEARINGS

**Nicholas Nwaribe**
*National Aviation University, Kyiv*
*Scientific supervisor – Gvozdetsky I.I., PhD, Associate Professor*

**Introduction** A magnetic bearing is a form of bearing that uses magnetic levitation to support a load. Moving parts are supported by magnetic bearings without any physical contact. For example, they can levitate a spinning shaft and allow relative motion with very little friction and no mechanical wear. Magnetic bearings support the highest speeds of any kind of bearing and have no maximum relative speed.

**Principle of operation** A full radial magnetic bearing may be used to stabilize the shaft of a rotating machine, can be seen in the diagram below (aircraft engine rotor). The rotor is controlled by two control axes (X & Y), each with a pair of electromagnets pulling it in opposite directions. All industrial AMBs employ a bias flux to linearize the force current relationship of the actuator. The bias is generated in the bearing of Figure 2 by passing a steady bias current through the all of the coils. The MBC adds a control current to adjust the net current up or down from the bias level as needed to maintain desired position.

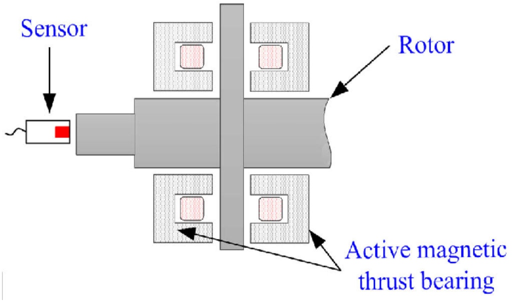
**Design** An active magnetic bearing works on the principle of electromagnetic suspension based on the induction of eddy currents in a rotating conductor [1]. As the electrically conductive material moves in the magnetic field, a current is induced in the material that counteracts the change in the magnetic field (known as Lenz's Law). This generates a current that will result in a magnetic field that is oriented opposite to the one from the magnet. The electrically conductive material thus acts as a magnetic mirror.




**Active magnet bearings in aircraft engines** A full radial magnetic bearing may be used to stabilize the shaft of a rotating machine, can be seen in the diagram below (aircraft engine rotor). The rotor is controlled by two control axes (X & Y), each with a pair of electromagnets pulling it in opposite directions. All industrial AMBs employ a bias flux to linearize the force current relationship of the actuator. The bias is generated in the bearing of the Figure by passing a steady bias current through the all of the coils. The MBC adds a control current to adjust the net current up or down from the bias level as needed to maintain desired position.

**Axial support bearing** Electromagnets in a form of non-removable ring located on both sides mounted on the shaft of the thrust disk. The electromagnets are fixed to the stator. Thrust plate is mounted on the rotor (for example, by shrink fitting). Axial position sensors, usually located at the ends of the shaft.

**Factors to consider when calculating for magnetic bearings**




When calculating for the AMB several factors should be considered: the air gap is needed in order to prevent collision with casing; the rotational speed needs to be calculated in order to calibrate the sensor signal; the electro-magnetic force depends on the loop count, the current, the wire size, and the presence of an iron core.

**Benefits: Energy efficient:** Their low power losses allow machines to attain faster running speeds, higher efficiency and longer service life than traditional bearings. AMBs can also be used under harsh environmental situations, including extremely low temperatures, zero gravity and corrosive environments. AMB systems don't need lubrication systems, making them virtually maintenance-free, reducing initial costs as well as operating and maintenance costs [2].

**Limitations: Loses:**The eddy-current losses (Pe) arise when the flux density within the iron core changes. A compact core acts like a short circuit winding and generates large eddy currents. The eddy-current losses can be reduced by dividing the iron core in insulated sheets, or in particles (sinter cores). **Precision**: Active magnetic bearings levitate an object, rotating or not, with feedback control of measured displacement sensor signal. The performance of AMB systems is therefore directly affected by the quality of a sensor signal. **High temperature:** In order to utilize the full advantages of active magnetic bearings, operation in gas turbine and aircraft engines requires that the magnetic bearing should work properly at high temperatures quite successful, but the long-term exposure to high temperature needs further research, as the actual results are not yet convincing [2].

**Conclusion:** The active magnet bearings have several advantages when compared to other bearings. Since they have been discovered they have brought a lot of benefits to the manufacturing sector. The active magnetic bearings work by suspending a rotor or shaft using electromagnetic forces. Due to the use of electromagnetic force, wearing and frictional forces are absent. These bearings also allow for quiet and environmentally friendly operation due to absent of friction and oil evoparation. The active magnet bearings today aren't used in aircraft engines but research is still being conducted to further optimize them for aircraft engines.

**References**

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