COMSOL simulations of assemblies of sub-millimeter NdFeB -based magnets

O. Manos[1], A. Sigalos[1],D. Niarchos[1,2]
[1]Amen New Technologies, Athens, Greece
[2] INN, NCSR Demokritos, Athens, Greece
A. Lixanrdu and C. Vogler
Huawei Technologies Austria GmbH, Wienna, Austria

Magnetic measuring offers numerous advantages over other positioning and measuring methods for industrial applications allowing the measurement of a distance with high accuracy attributed to the magnetic field's irrelevance to the non-magnetic disturbances such as dirt, dust, or liquid droplets. A typical measuring solution consists of a measuring head with a magnetic field sensor and a magnetic linear scale composed of a highly accurate pattern of magnetic North(N) and South(S) poles. Via counting the number of NS alternations the distance is determined with high accuracy and sensitivity.

Ferrite-based micromagnets are the building block materials of the current state-of-the-art magnetic scale applications presenting a favorable compromise between the desired properties and costs. However, these structures provide the lowest magnetic field strength of all permanent magnetic materials with a direct consequence on the sensitivity of magnetic scale applications. In addition, the current magnetic scale fabrication processes aim to fabricate discreet micromagnets involving several fabrication steps which complicate the production procedures and increase the production time and costs significantly.

We propose the replacement of Ferrite-based micromagnets with NdFeB ones which deliver up to 20 times stronger magnetic field per unit volume leading to enhanced sensitivity and accuracy of these structures. Our new generation NdFeB-based magnetic scales present smaller pole pitch, improved tolerance, and position accuracy compared to their Ferrite-based counterparts. Simulated results using a COMSOL software will be compared with experimental data.

Here some simulations

Figure 1. a) The simulated B_z profile contributions of our home-built magnetizer. b) B_z profile patterned on the unmagnetized NdFeB rod.