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Institut für Elektrotechnik, Elektronik und Informationstechnik

Improved Hysteresis of GMR Sensors by means of Digital Signal Conditioning

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With the fast development of the technologies for creating new materials, a great number of interesting and useful phenomena have been discovered in almost every domain. In the area of magnetics one of these was the magnetoresistive (MR) effect, which is based on the change of the resistance in a multi-layer system, under the influence of an external magnetic field. The breakthrough for these devices was the possibility of creating very thin metallic layers (in the domain of nm). This constriction to a surface phenomenon led to different magnetic properties than the known ones. All these effects are measured in the relative change of resistance ($\Delta R/R$) and, depending on the configuration and type of the layers, they can be of different types and magnitude. Historically, the first one was the AMR (Anisotropic Magnetoresistance), with a value of 3% for $\Delta R/R$ at room temperature. It was followed by GMR (Giant Magnetoresistance), with around 10% (for GMR-spin valve), Tunnel Magnetoresistance (TMR), with up to 100% (TMR-spin valve) and 200-400% for the CMR (Colossal Magnetoresistance).

In every sensor or transducer system, one of the most important steps in being able to make a correct and accurate measurement is transforming the "raw" signal of the sensing element into a well calibrated, standardised output. This applies in particular to GMR sensor elements. Due to the high accuracy required for many applications even small hysteresis and other nonlinearities, offsets and perturbances should be compensated by electronics. To achieve an accurate measurement a novel model was developed and loaded to a DSC (Digital Signal Controller) for real time hysteresis compensation. The result of combining GMR-Technology with fast digital signal conditioning is shown for the application as ultra compact current transducers.