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A Linear Magnetic Stray Flux Array Based on GMR Gradiometers

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Abstract

The dramatic increase in storage density in magnetic media had a strong impact on the development of new sensor concepts for measurement of weak magnetic fields. Two prerequisites were miniaturization and the efficiency of the effect used. A number of magnetic field sensors based on various mechanisms has been developed and found applications in information storage technology, mechanical engineering and automotive industry. It is attractive to use such sensors for special applications in nondestructive testing (NDT) i.e. eddy-current testing with high penetration and on-line monitoring. Compared to the most conventional sensors the sensitivity of such sensors based on giant magneto-resistance (GMR) effect is higher, so smaller pre-magnetization fields are necessary. Based on a commercial GMR chip, we have built up an array with 16 gradiometer sensors arranged in a line with a pitch of 4 mm. A pre-magnetization device and multiplexer are integrated in the sensor head. A PC data acquisition board digitizes the output signals of the array. For spatial filtering a wavelet transformation algorithm based on Doubechies wavelet is used. The sensor array was tested on samples in different forms with artificial surface and sub-surface defects in various depths and widths as well as for natural defects. An outlook on the design of equipment including special sensor-on-chip technologies fit for industrial application is presented.