Univerza v Ljubljani
Fakulteta za elektrotehniko

ON WAFER CHARACTERISATION OF THE ANALOG ANISOTROPIC MAGNETORESISTANCE SENSOR

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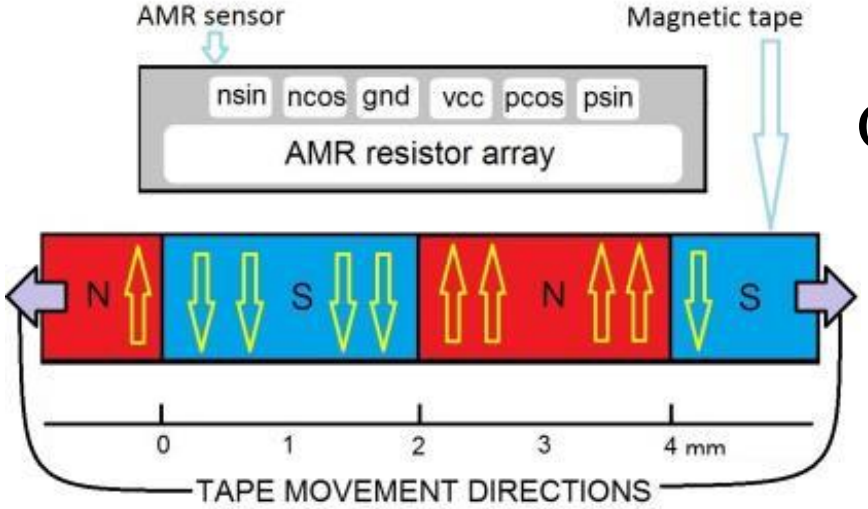
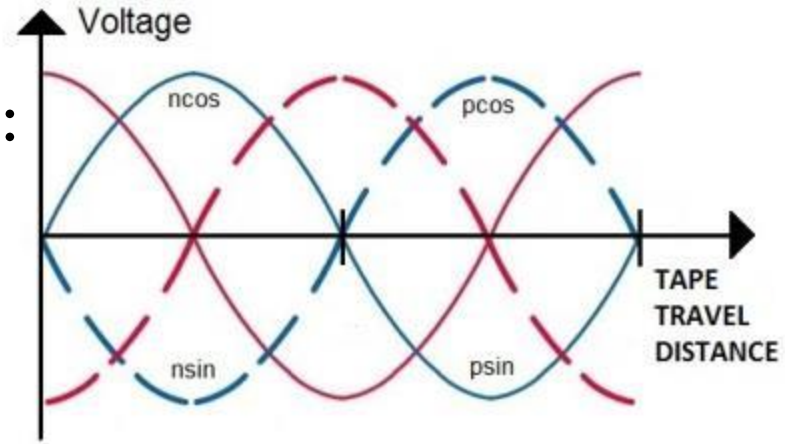
Janez Trontelj ml. graduated in computer science in 1988. He got a job at the University of Ljubljana, Faculty of Electrical Engineering, where he received his master's degree in 1991 and his Ph.D. degree in 1994. Since then, he is working in Laboratory for Microelectronics at the Faculty of Electrical Engineering as a senior software engineer, ASIC designer, and ASIC test software developer for several industrial projects.

Motivation

- Wafer sort of Anisotropic Magnetoresistive sensors (AMR).
- Utilizes changing magnetic field for detecting movement, rotation or position.
- Example of AMR sensor application:

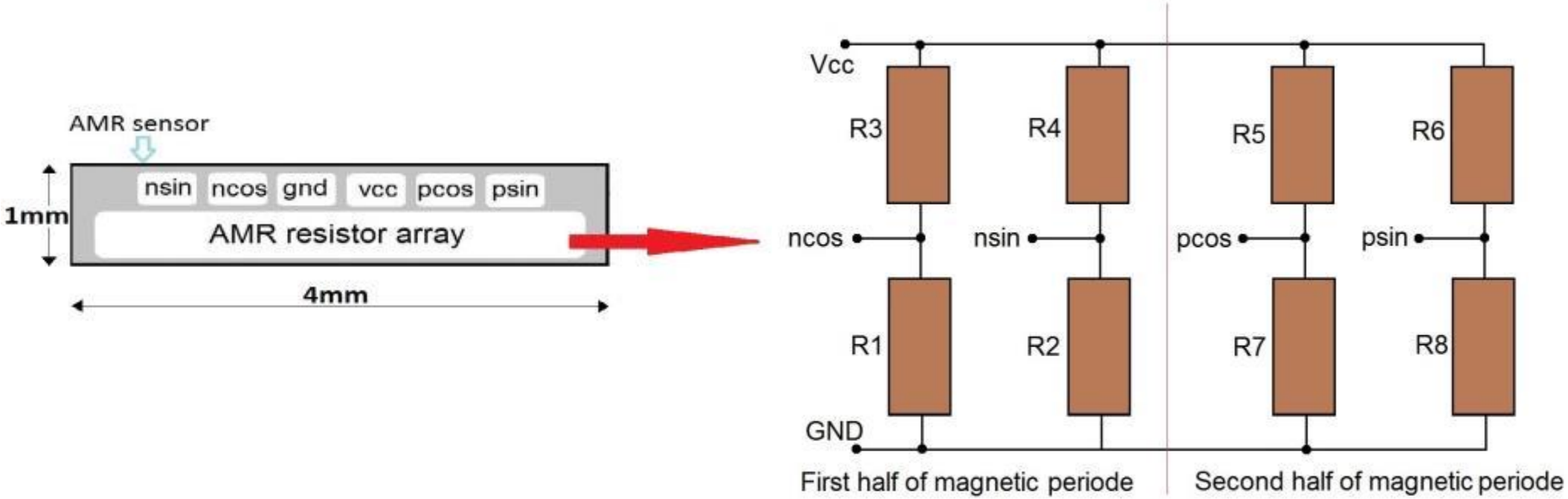


Output signal:



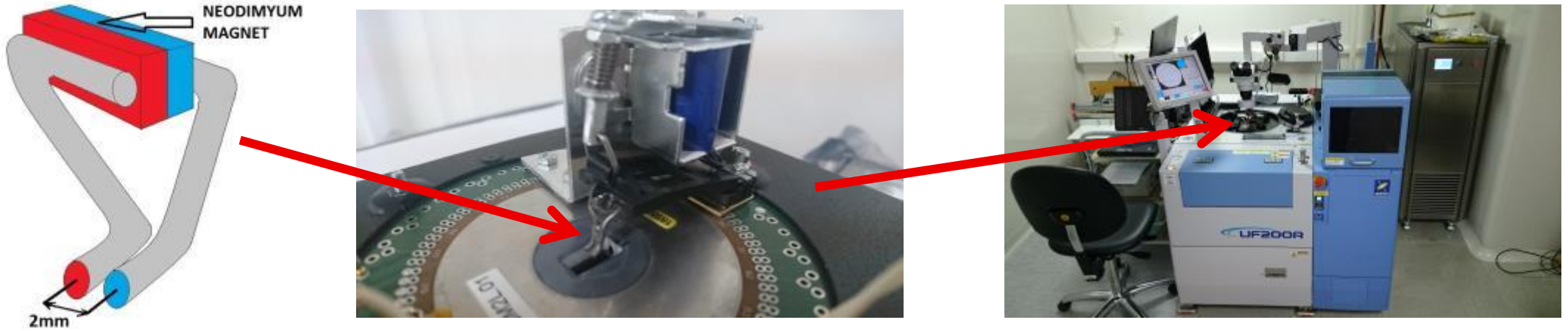
- Key parameters are resistance, offset, sensitivity, and hysteresis.

AMR equivalent circuit



In this article, we will focus on the sensitivity measurement.

AMR sensitivity measurement



- Custom made structure from a soft ferromagnetic material.
- The magnetic field should be as parallel to the wafer surface as possible.
- Magnetic field strength is app. 30mT.
- It takes 25ms to create a magnetic field near the AMR sensor.

Measurement repeatability

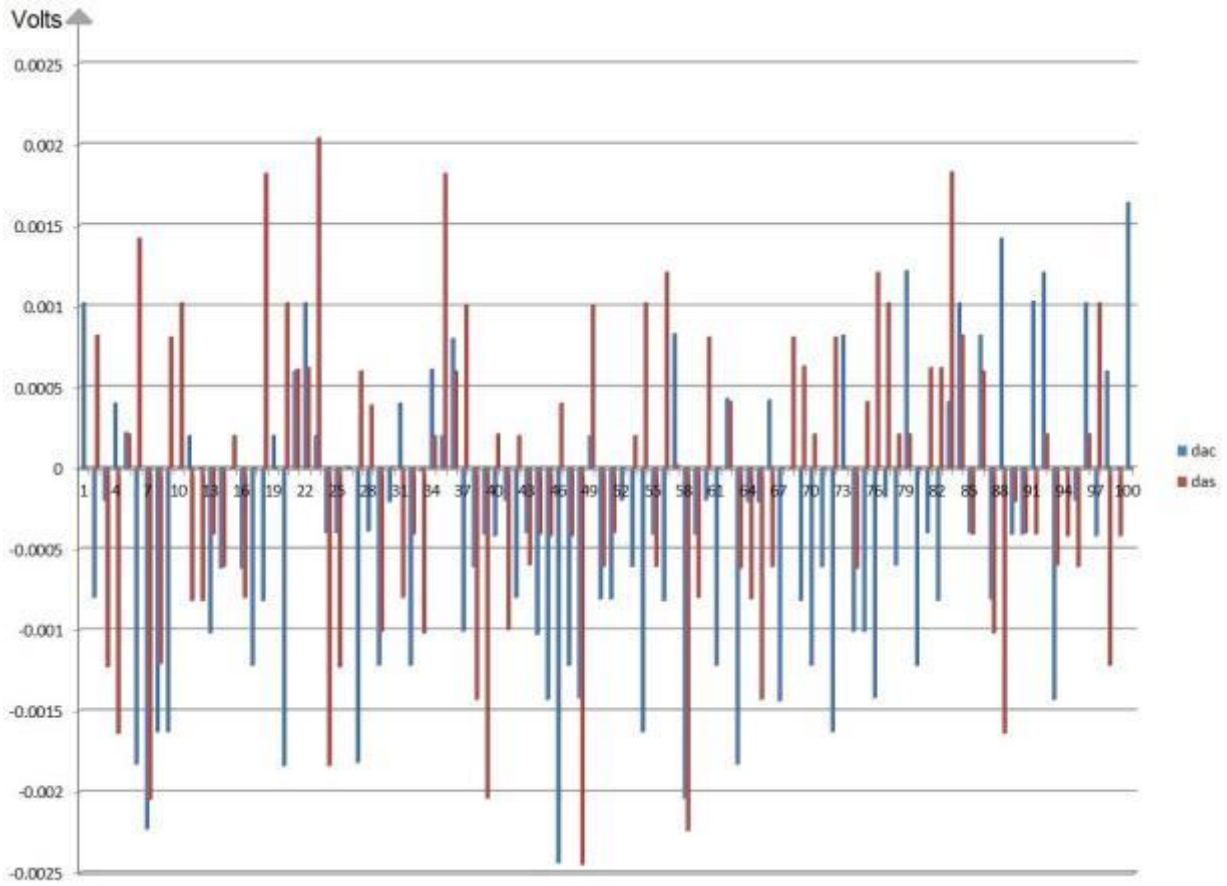


Chart shows differences between two AMR sensitivity amplitude measurements with an interval of one day for 100 AMR devices on a silicon wafer with a standard deviation of 0.9mV.

Results

- Using this method, we have successfully tested several thousand analog AMR sensors so far.

- This approach significantly shortened the development time of the AMR sensor.

- The measured values on the silicon wafer correspond to the measurement values next to the magnetic tape.

	measurement1	measurement2	measurement3	
Tape Distance	0.10	0.50	1.00	mm
Resistance	0.9316	0.9362	0.9418	kOhm
Amplitude sin	66.74	65.91	60.96	mV
Amplitude cos	66.69	65.83	60.85	mV
Offset sin	3.80	4.15	3.97	±mv
Offset cos	4.92	4.94	4.86	±mV
Hysteresis	0.00	0.9	4.24	µm

Conclusion

- We described the possibility of measuring the analog AMR sensor sensitivity on the silicon wafer.
- The achieved accuracy and repeatability is good enough for a harsh wafer prober environment.
- Unfortunately, this method can not be used to measure the hysteresis of the AMR sensor.

Future work

- We have further developed our solution to enable also the hysteresis measurements. This solution is currently patent pending and will be published shortly.

- We see further improvement of the overall process in fine trimming the AMR sensor geometry and fabrication process.

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Thank you! Questions?

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