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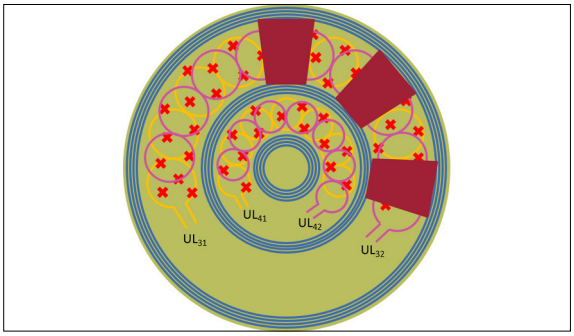
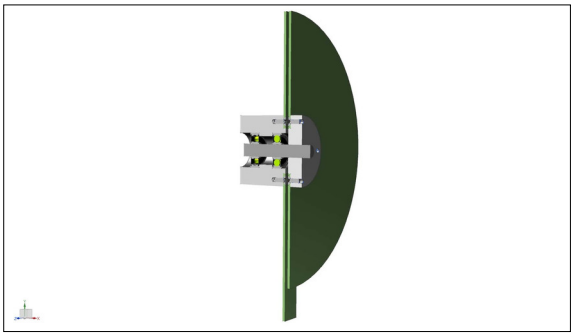
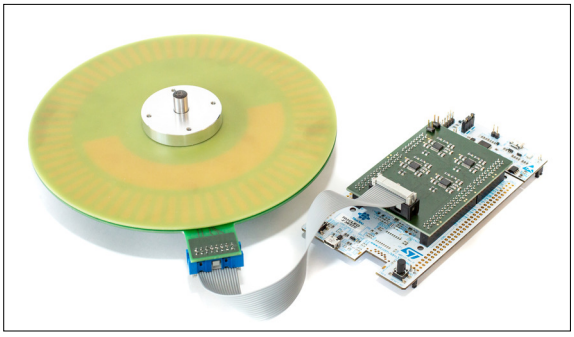
Subject Area	Microelectronics

Inductive Rotary Position Sensor based on PCB Technology



Sensor coil PCB concept animation


3D visualisation of mechanical mounting


Complete sensor system

Introduction: Linear and rotary position sensors play a key role in terms of automation and robotics. There exists a wide variety of different approaches concerning their construction. Inductive sensors work by the converter principle which uses the physical phenomenon based on the eddy currents. Inductive sensors are very robust, accurate and reliable due to the fact that they only consist of wrapped coils and metal parts. On the other hand, they are considerably huge and heavy. The amount of metal and the necessity that the coils need to be wrapped carefully are major reasons why the production is expensive especially for highly accurate devices. To get rid of these disadvantages research facilities and companies have started developing inductive rotary position sensors based on printed circuit board (PCB) coils.

Objective: The challenge of the project is to develop an inductive rotary position sensor based on PCB technology. First of all, the basics and theory of inductive sensors and the signal processing need to be studied as well as available publications and patents of similar projects. Afterwards, a sensor model and possible front end circuits have to be developed and evaluated. They finally are designed as a PCB. For measurements and validation of the sensor, a mechanical mounting needs to be constructed. To visualise the measured angle, a graphical user interface (GUI) has to be designed. All calculations should be done on a microcontroller unit (MCU). In the end, the circuit is tested and thereafter well documented for further development. The final goal is to reach an electric resolution of 3.6 arcseconds which is about 1/1000 degree. If there is enough time, non-linearities can be compensated by means of software. In addition, the hardware can be upgraded for an absolute angle measurement.

Result: The developed inductive rotary position sensor consists of three PCBs. One provides the sensor coils, another works as a damping platform to block the electromagnetic field depending on the angle and the last one is an extension board which drives the LC resonator and provides the amplifier stage and the filter circuits. The extension board can be mounted directly on the MCU board STM32F303ZE. The board can be connected to a computer via universal serial bus (USB), where the calculated angle can be displayed with a practical and clear LabVIEW GUI. The sensor allows measuring an angle with an electric resolution of one arcsecond which is 1/3600 degree at an output transfer rate of 8 kHz. In comparison, the mechanical resolution has not the same quality. The reasons are on the one hand the imprecision of the mechanical mounting and on the other hand inaccuracies of the PCB shape, whose elimination is an important issue for the further development.