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Title:	**SAW magnetic Sensor: FEM modeling and experimental validation**
Abstract:	**1. Background, Motivation and Objective :** Demand for small, sensitive, accurate and wireless magnetic sensor record an important increase. Accurate modeling of SAW magnetic sensors including magnetostrictive materials requires to take into account the coupling between electrical, magnetic, mechanical, and acoustic domains. The aim of this work is to implement a full model using the Comsol multiphysics software, leading to predict the piezo-magnetic sensor sensitivity to the direction and intensity of an external applied magnetic field. Both resonators and delay lines will be considered and the model accuracy will be validated experimentally. **2. Statement of the Contribution/Methods** : A general finite element method (FEM) of two-dimensional piezo-magnetic devices is used. In the magnetostrictive thin film, a coupling between the AC/DC module and the structural mechanics module was implemented by adding appropriate terms to the subdomain variables for the strain and the magnetic fields. The coupled equations for the mechanical and magnetic systems allowing the determination of the dependence between the elastic constants and the applied magnetic field are detailed in Ref [1], A heterostructure Ni/ZnO/IDT/LN-Y128 SAW delay line was fabricated using conventional photolithography and two mask levels. The S21 frequency response was measured using a network analyzer at different steps of fabrication (IDT/LN, ZnO/IdT/LN, Ni/ZnO/IdT/LN) and compared to the simulated results. The final and packaged structure was then characterized under magnetic field.

	3. Results/Discussion : The methodology was first validated using a SAW resonator based on a Quartz substrate and Nickel IDTs. The variation of the resonance frequency, the quality factor and the electromechanical coupling coefficient were investigated versus the magnetic field intensity and its direction and compared to the experimental results published by Kadota [2]. The methodology was then considered to predict the sensor magnetic sensitivity of others structures. We studied theoretically and experimentally a SAW delay line based on Ni/ZnO/IDT/LN-Y128 layered structure. The latter structure shows a moderate sensitivity of 0.65 ppm/mT when the fundamental SAW is considered (159 MHz) and 3.6ppm/mT when considering the fifth pseudo-harmonic (810 MHz). When the Al2O3 was used as an insulator instead of ZnO, the sensitivity was enhanced by a factor 9 using a comparable operating frequency (31.5 ppm/m Tat 815 MHz). [1] O.BouMatar et al, J. Appl. Phys.111,054901 (2012) [2] M.Kadota et al,J J. Appl. Phys.51,07GC21(2012