An RFID-based Implant for Identification and Pressure Sensing of Orthopedic Prosthesis

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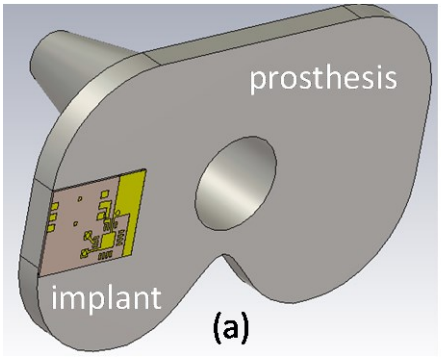
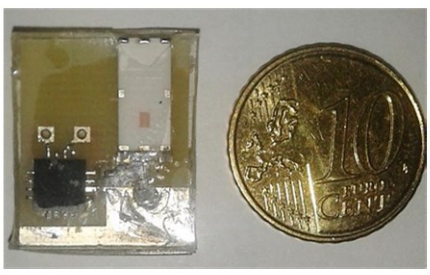
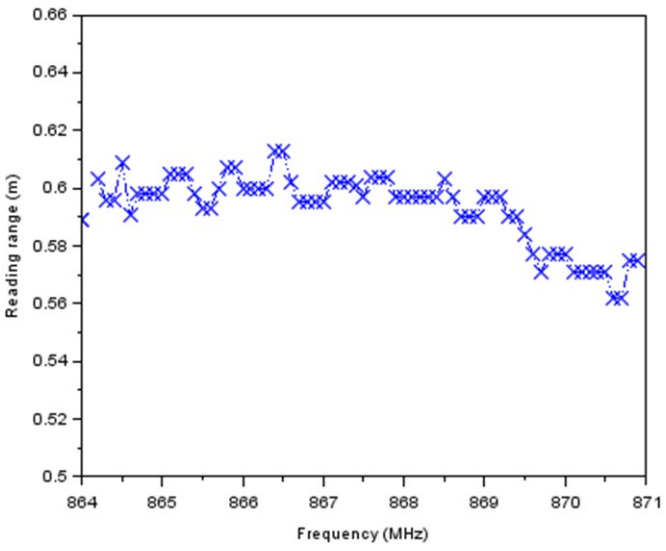
In this paper we focus on the design of a miniaturized implantable RFID sensor to enable remote identification and sensing for orthopedic prosthesis dedicated to hips and knees. The current issues to overcome in the world of orthopedic surgery are a better tracking of patient's implants integrity during the whole cycle life of the prosthesis. Second, in case the prosthesis should be changed, it would be interesting to have a clear picture of the prosthesis model before the surgical operation to be sure that no surprise arises during the operation. The RFID is a technology which can perfectly match these required key points. A passive RFID tag doesn't need any local battery supply since it harvests energy from the electromagnetic (EM) field of the reader. In its simplest form it is composed of an antenna connected to a chip. The technology involved is shared mainly between HF technologies based on near field communication principle, and UHF technology (867 MHz in Europe). In this paper we study the possibility to design an implant based on UHF RFID tag. Even though, the wireless link losses are higher in human body tissues, the main interest to compare with HF RFID is the higher read range capability (up to several meters) which is more compatible with the aforementioned application for which a detection distance of 50 cm is needed. In order to sense if the prosthesis is properly inserted within the bone, and if it doesn't show any tilt, a pressure sensor is attached to the dedicated RFID IC SL900A from AMS with no additional components as shown in Fig. 1 (a). In order to miniaturize the implant, a ceramic chip antenna operating around 900 MHz is connected to the AMS IC (see Fig. 1 (b)). The whole assembly made of the pressure sensor, the IC and the antenna is coated with PDMS silicon-based resin. This makes a flexible 20x20mm^2 RFID-enabled sensor operating at a distance in free space up to 0.6 meter in passive mode as shown in Fig. 1 (c).





(b)



(c)