Monitoring intravascular pressure with a pulmonary artery pressure sensor system

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In the context of the COMPASS project an implantable system for telemonitoring the intravascular pressure in the pulmonary artery is developed. By implanting a catheter-bound pressure and temperature sensor into the pulmonary artery, it is possible to monitor the actual value and the time variations of the intravascular pressure. Thus hospitalization of patients suffering from heart insufficiency can be avoided by early changes in therapy.

A considerable number of people in Europe suffer from congestive heart failure. In Germany, the number reaches around 1.8 million, rising by 2 - 300,000 each year [1] which poses a substantial economic problem. As it is one of the most frequent non-surgical diseases with recurring hospitalization and high mortality, a strategy to lower the costs is required.

Patients can be monitored by measuring the pulmonary artery pressure and deriving the cardiac output by means of a modified pulse contour analysis. This gives information about the physical health of the patient and serves as an early warning system for the physician. Risk of infection, however, would be given if parts of the monitoring system were situated outside the body. Therefore, a fully implantable system is presented which includes a catheter-bound pressure and temperature sensor inside the pulmonary artery. It enables the physician to monitor the actual value and the time variations of the intravascular pressure.

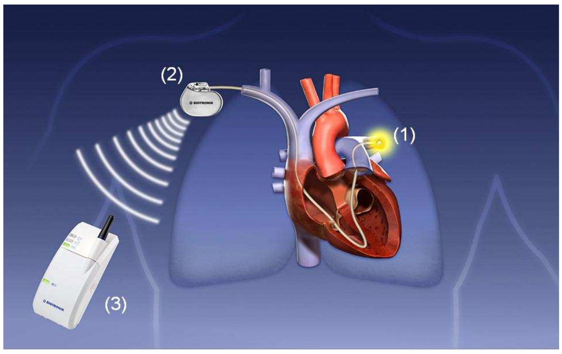

FIG. 1: *COMPASS System*

The system, as seen in FIG. 1, consists of a capacitive pressure sensor which is integrated in a catheter holding the sensor cable (1). This cable is connected to subcutaneous implanted electronics enclosed in a biocompatible housing (2). Besides the interface to the pressure sensor the implanted electronics contain a telemetric unit, a battery, a processor and an internal memory. It is able to communicate wirelessly with a home monitoring station (3). The data can be transferred by mobile communication via a service center to the attending physician.

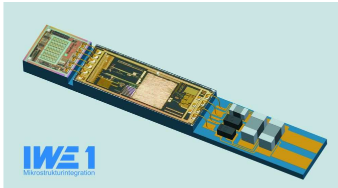

FIG. 2: *Sensor Element*

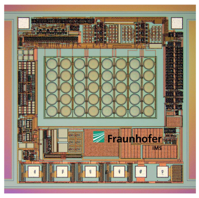

FIG. 3: *Capacitive Pressure Sensor*

The sensor element, as shown in FIG. 2, contains two silicon chips. One is a monolithically integrated pressure and temperature sensor (FIG. 3), similar to the one presented in [2]. The other is an additional interface circuit amplifying the signal gained from the sensors. This allows the signal transmission over the long distance between sensor and telemetric unit.

The main development at IWE1 is the assembly process of the sensor element. It has to be proven stable and has to minimize stress on the capacitive pressure sensor measuring the pulmonary artery pressure. By avoiding stress on the sensor, the measurements will give stable results and the drift will be reduced to a minimum.

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Project partners

- Helmholtz Institute for Applied Medical Engineering http://www.ame.hia.rwth-aachen.de/
- Fraunhofer IMS Duisburg http://www.ims.fraunhofer.de/
- BIOTRONIK SE & Co. KG http://www.biotronik.de/

[1] M. Fischer, A. Baessler, S. R. Holmer, M. Muscholl et al., *Zeitschrift fuer Kardiologie*, vol. 92, no. 4, pp. 294-302, Apr.2003.

[2] H. Fassbender, U. Urban, M. Görtz, T. Göttsche, K. Trieu, W. Mokwa, and T. Schmitz-Rode, in *The Seventh IEEE Conference on SENSORS* 2008, pp. 1226-1229.