

An Application Example of Sensor Data Fusion – Magnetic Localization of a Medical Tube inside the Human Body

Till Riemschneider *), Thorben Schütthe **), Karl-Ragmar Riemschneider **)

*) Department of Anesthesiology and Intensive Care, Medical Faculty, Otto von Guericke University of Magdeburg

**) Faculty of Electrical Engineering, Media and Information Technology, Hamburg University of Applied Sciences

For many critically ill patients, artificial ventilation is required. In intensive care, this is often performed using a tube that is inserted into the trachea.

This endotracheal tube that must remain in the correct position over an extended period of time. At present, the tube placement position is checked at short intervals by medical staff through visual inspection.

An experimental system for automated monitoring based on magnetic localization is presented, considering both technical feasibility and medical applicability.

For this purpose, a ring-shaped permanent magnet is attached to the tube, and a device placed outside the patient detects the magnetic field.

This device measures the field components using 64 magnetic sensors arranged in an 8×8 matrix. From these amount of vector data, the position of the tube is continuously estimated.

Two approaches to sensor data fusion are investigated interdisciplinary:

(I) Two-dimensional image similarity – cross-correlation of vector-valued sensor maps, in which a reference matrix is compared with the current measurement.

(II) Model-based localization – the inverse problem is solved by adjusting the position and orientation parameters of a magnetic field model.

This is achieved by stepwise stochastic optimization in order to minimize the deviation between the model and the measured data.

Both methods can be realized with reasonable computational effort and enable continuous real-time monitoring.

The system triggers an alarm as soon as an impermissible displacement is detected, and can thus provide early indications even of small positional changes.

In this way, a contribution could be made to improving patient safety.