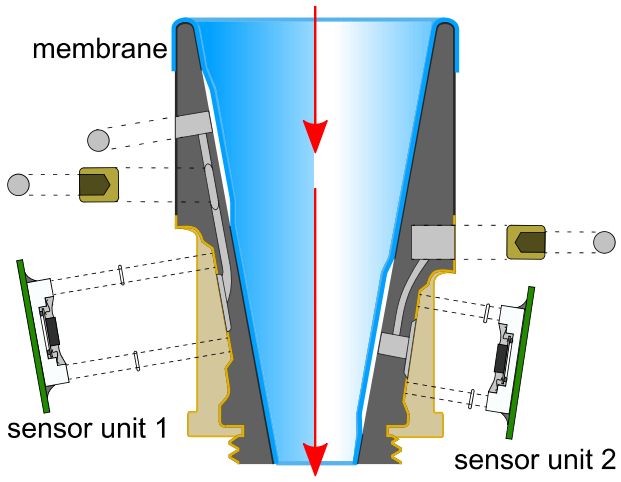
ETH zürich

Licensing Opportunity

Integration of combined total pressure and flow sensor for monitoring and control of blood pumps



(left) The Abbott HeartMate 3 with modified inflow cannula, (right) scheme of cannula with two embedded pressure sensors.

Application

An implanted sensor system provides total pressure and flow rate waveforms as the input signal for controllers that match the pump speed of blood pumps to the physiological needs of the patient. The sensor system is an add-on to existing ventricular assist devices, which seamlessly integrates into the inflow cannula of the pump.

Features & Benefits

- Real-time monitoring of the blood pressure in the heart chamber and blood flow through the pump
- Seamless integration into the cannula walls with no effect on blood flow
- Measurement of flow-independent total pressure
- Miniaturization to retain conventional cannula geometry

Publications

- "Pressure and Bernoulli-based Flow Measurement via a Tapered Inflow VAD Cannula," in IEEE Transactions on Biomedical Engineering, https://doi.org/10.1109/TBME.2021.3123983

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Technology Readiness Level

Background

Commercially available implantable blood pumps do not adapt their output to the patient's changing perfusion needs, which depend, for example, on his or her physical activity. As a result, overpumping and underpumping occur and contribute to the occurrence of complications such as pump thrombosis, collapse of the heart chamber or insufficient opening of the aortic valve. Continuous measurement of hemodynamic parameters is needed to aid clinicians in decision making and ultimately enable future implementation of algorithms to automatically adjust pump output.

Invention

The invention relates to the integration of a pressure sensor system into the walls of a blood carrying tubular structure and the manufacturing thereof. The sensing interface is provided by a polymer coating of the tubular structure, that forms a freely suspended diaphragm over a small opening of a cavity within the walls. The cavity contains a piezoelectric pressure sensor and is filled with a pressure transmission fluid. The invention covers a sealing mechanism and diaphragm shapes that reduce sealing- and temperature-induced overpressure on the membrane and consequent signal drift. Multiple of such sensors of static pressure can be placed at different cross sections within the tubular structure where they experience different flow velocities. This induces pressure differences between the sensors and allows to calculate a flow-independent total pressure and the flow rate from at least two static pressure sensors.