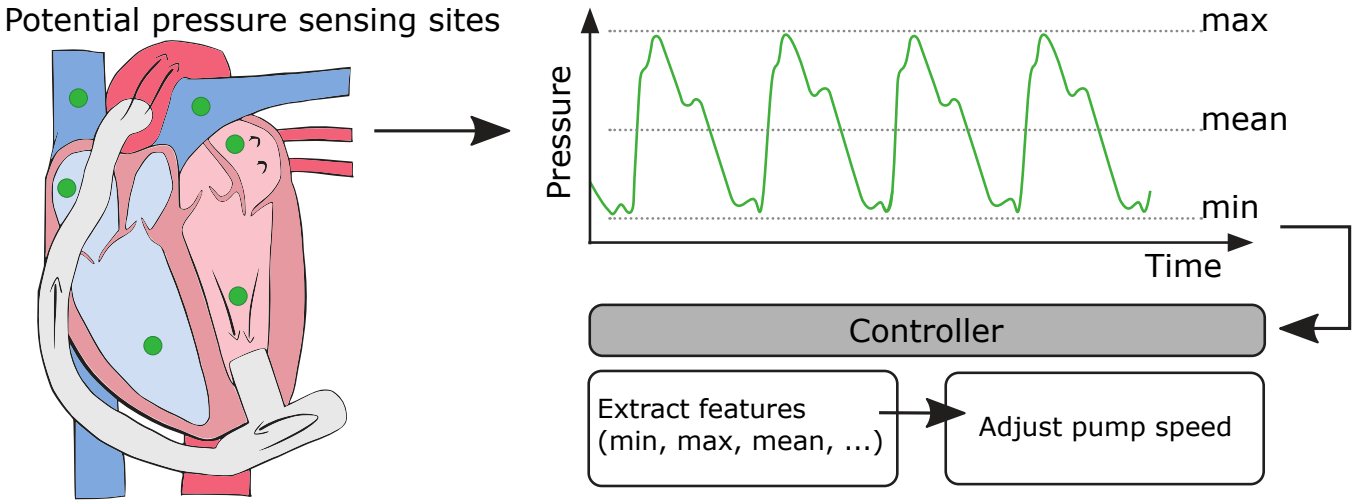
ETH zürich

Licensing Opportunity

Multi-mode physiological controller for blood pumps based on implanted pressure sensors



(left) Heart with an inflow cannula and possible placements of pressor sensors, (right) simplified control scheme for a Ventricular Assist Device (VAD) based on the blood pressure of the patient.

Application

A blood pump adjusts its output according to the patient's perfusion needs based on blood pressures measured by implanted sensors. The system is flexible with respect to the placement of sensors at different locations in the cardiovascular system, as the controller can switch between multiple placement-dependent pre-sets.

Features & Benefits

- Flexibility of pressure sensor positioning
- Implementation of various control rationales (min, max, mean or other characteristics of pressure waveform)
- Re-adjustment of pump operation after each heart beat

Publications

- "A Physiological Controller for Turbodynamic Ventricular Assist Devices Based on Left Ventricular Systolic Pressure," Artif. Organs 2016, 40(9), 842–855 https://doi.org/10.1111/aor.12820
- "In Vivo Evaluation of Physiologic Control Algorithms for Left Ventricular Assist Devices Based on Left Ventricular Volume or Pressure," ASAIO Journal 2017, 63(5), 568-577 https://doi.org/10.1097/MAT.0000000000000533

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Technology Readiness Level

1 2 3 4 **5** 6 7 8 9

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

A physiological controller for blood pumps can operate on pressure signals from different locations in the cardiovascular system. The pressure sensors can be placed in the left or right ventricle, the pulmonary arterial circulation, the left or right atrium or the pulmonary or systemic vein and can transmit pressure data and position identifiers wirelessly to the controller. The controller runs a pre-set algorithm depending on the location of the pressure sensors. The algorithm extracts different metrics from the pressure signal such as the preload of the heart based on the minimum pressure, the maximum pressure, the mean pressure or the pressure at a specific point in time during one cardiac cycle. The controller includes several signal filters and regulates the pump output in a linear relationship to the estimated preload. It can furthermore superimpose a periodic modulation of the pump output synchronized to the heart beat.