

# **Ultrasonic Blood Flowmeter with a Modified Zero-crossing Transit-time Measurement Algorithm for an Artificial Heart Pump System**

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According to clinical observations, many issues related to the blood flow in artificial heart devices have been revealed. To resolve the issues, an equipment capable of measuring an accurate flow rate needs to be developed. As the device for measurement of the flow rate, an ultrasonic flow meter (UFM) has been well-known to be the useful devices because of those non-invasive characteristics that physically do not affect the flow of the fluid. This study demonstrates UFM for an artificial heart pump system with a transit-time measurement (TTM) method, which is revealed to be the most accurate and the simplest method of the UFM. To build the UFM system with TTM method, ultrasonic flow sensors with 5.5 MHz transducers and a modified zero-crossing algorithm-based transit-time measurement method (ZC-TTM) have been developed. We computed the flow rates at different motor speeds using a conventional cross-correlation algorithm-based time delay measurement method (CC-TDM) and the ZC-TTM for evaluating the performance of the proposed method. The results demonstrated that the ZC-TTM had better performance to measure more accurate flow rates than the CC-TDM. Thus, this system has the potential to be a promising tool for acquiring blood flow information for the artificial heart pump system.