



# Joseph Bornoff's Simulations of the Realheart Published in Scientific Reports

Press Release 18 April, 2023

**Realheart has several international collaborations with researchers and PhD students to develop the world's first four-chamber heart. One of these is Joseph Bornoff, a PhD student at the University of Bath in the UK. Bornoff has developed an advanced Computational Fluid Dynamics (CFD) model of the Realheart® TAH (Total Artificial Heart) to study blood flow in the pump and optimize its function. The work, co-authored with colleagues at Realheart, has now been published in the Springer Nature journal Scientific Reports.**

The Realheart model can be simulated across a wide range of operating conditions where variations in heart rate and stroke volume were investigated. The model was validated using Assistant Professor Libera Fresiello's hybrid simulator, a work published in the scientific journal *Artificial Organs* in 2022, and showed excellent agreement between simulation and experimental results. The computational model builds upon previous work by Joseph where he developed a fluid-structure interaction method to simulate complex valve motion.

Based on detailed descriptions of the background, methodology and results, Joseph concluded that the risk of blood damage was low, thanks to the low levels of shear stress in the pump. In addition, the excellent drainage of blood through the pump during operation was comparable to other similar devices examined, suggesting that the thrombogenic potential was low.

Bornoff holds a first class MEng (Hons) in Mechanical Engineering from the University of Bath, and is currently undertaking a PhD at the University of Bath, where he is researching a multiscale analysis of a novel total artificial heart, in collaboration with Scandinavian Real Heart since 2020. Bornoff is active in several research areas, such as fluid-structure interaction, artificial hearts, and numerical models and computational fluid dynamics.

"The use of computational modelling enables us to increase productivity in development of the Realheart TAH and future products by enabling reduced testing with simultaneous increased understanding of links between form and function. This puts us in the forefront of sophisticated preclinical testing methodology that saves resources and reduces the need for animal testing" said Ina Laura Perkins, CEO of Realheart.

Scientific Reports is a globally renowned peer-reviewed journal that covers all areas of the natural sciences, psychology, medicine, and engineering, and was the 5th most-cited journal in the world in 2021. Joseph Bornoff's article: "Fluid-structure interaction modelling of a positive-displacement Total Artificial Heart" has been published in the *Artificial Organs* collection which covers new methods applicable to improving artificial organs, or studies assessing their function, and is online here: <http://rdcu.be/c9T04>

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*Scandinavian Real Heart AB develops a total artificial heart (TAH) for implantation in patients with life-threatening heart failure. Realheart® TAH has a patented design that resembles that of the natural human heart. The artificial heart consists of a four-chamber system (two atria and two ventricles) designed to generate a physiological blood flow pattern that mimics the body's natural circulation. A unique concept in the medical technology world.*