Cardiovascular disease is the leading cause of death in developed countries. Often narrowing or widening of vessels disrupts normal blood flow. Measuring blood flow in the vessels in the body is therefore essential for diagnosis, monitoring, and treatment planning. Magnetic Resonance Imaging provides pictures of the inside of the human body and can also measure blood flow velocity (so-called Qflow MRI). Four-dimensional Qflow provides not just 2D images, but complete 3D blood velocities throughout the cardiac cycle. Qflow MRI creates a huge quantity of data that clinicians cannot interpret directly, slice by slice. To address this problem, Fred has developed a flow analysis software application.

The 4D flow analysis application allows clinicians to derive measurements from the MRI data, such as the total volume of blood flowing through a vessel at a point of interest. Points of interest can be selected easily on a 3D rendering of vessels, extracted from the measured velocities. This simplifies flow measurement compared to the currently used 2D Qflow technique, where the position has to be specified before the scan. The analysis of MRI flow data is also no longer limited to slices that are selected before the scan. The application allows a clinician to inspect the data interactively, by creating as many measurements as necessary, and changing the points of interest at will.

Next to the amount of blood flowing through a vessel, the dynamic nature of blood flow is interesting for researchers to understand the nature of the disease better. For example abnormal flow promotes thrombosis. To determine what flow patterns are problematic is an interesting subject of study. The 4D flow applications incorporate a number of 2D, 3D, and animated visualization techniques, such as glyphs, streamlines, and velocity profiles, to facilitate the study of 4D MRI flow.

**Benefits**

The 4D flow application assists clinical researchers in obtaining insight into the development of cardiovascular disease. Compared to 2D flow imaging, 4D flow can improve clinical workflow by eliminating the slice selection step prior to scanning and improve analysis by interactive repositioning of measurements afterwards. Furthermore, it gives better insight into the dynamic 3D nature of blood flow.