Magnetic Resonance Velocimetry Through a U-Bend challenge

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ABSTRACT

The MRV challenge was issued to several institutions to investigate turbulent fluid flow through a relatively simple U-bend geometry. Each group used similar geometric dimensions and experimental conditions to obtain comparable data, and ultimately determine the accuracy and efficiency of each MR scanner and post processing techniques. We outperformed the four other research groups in efficiency while also producing analogously accurate results
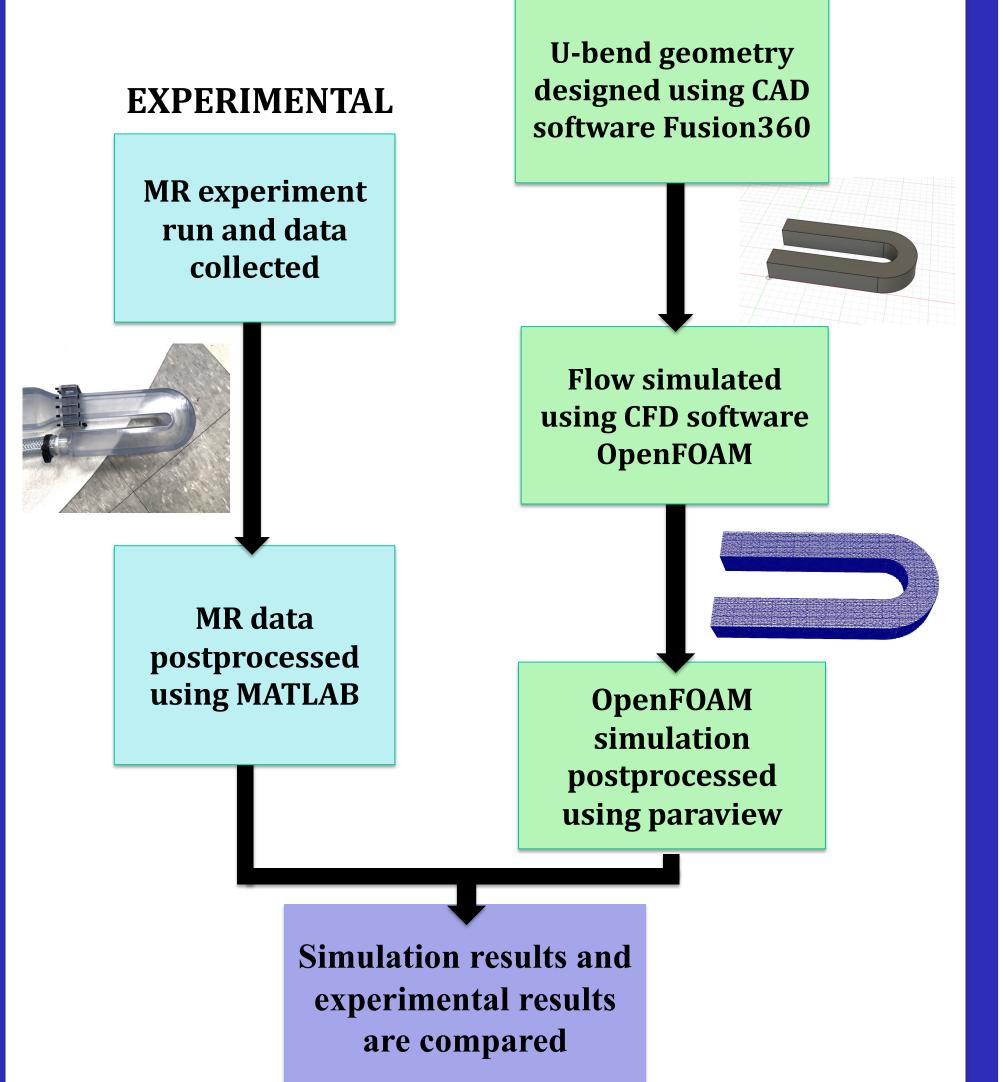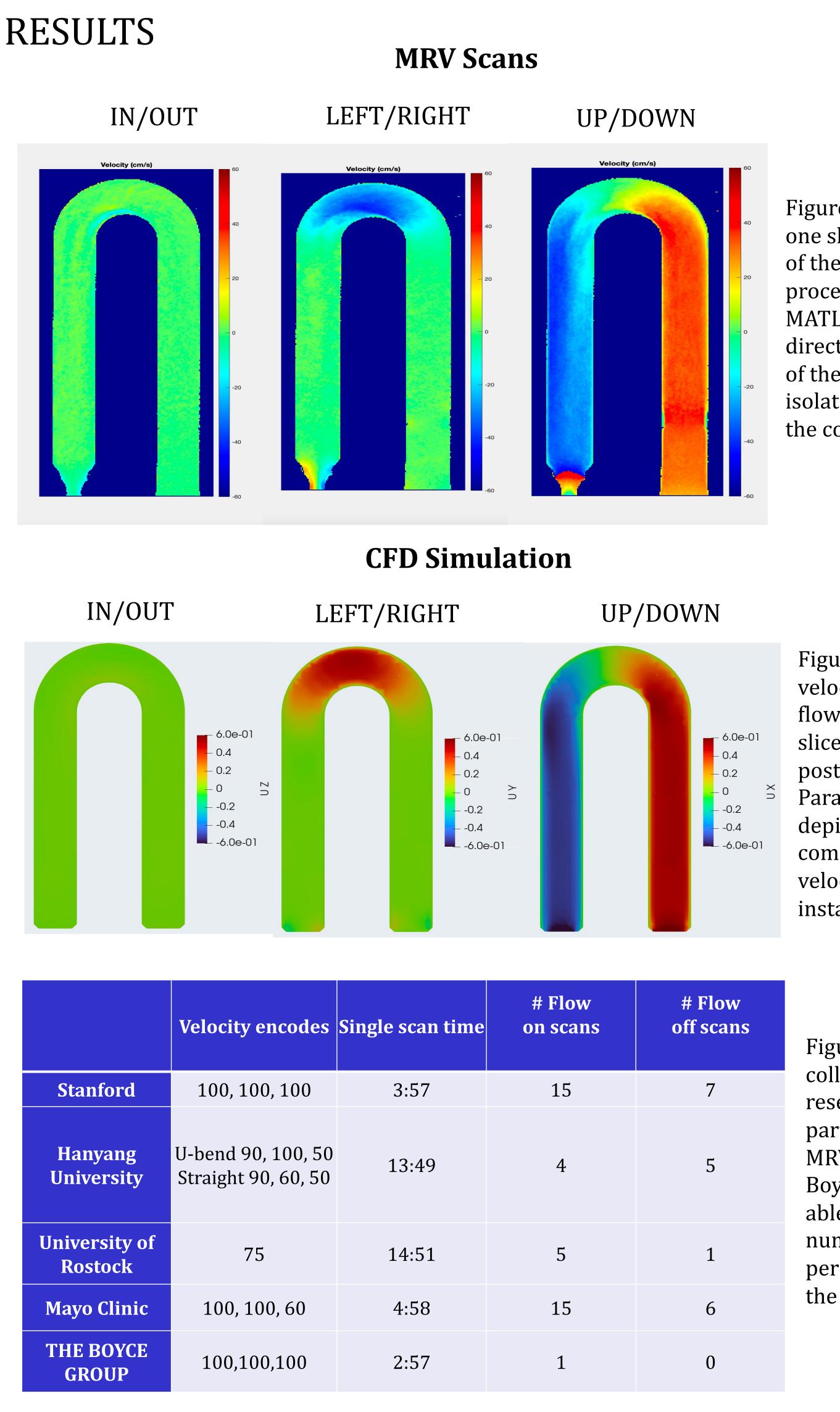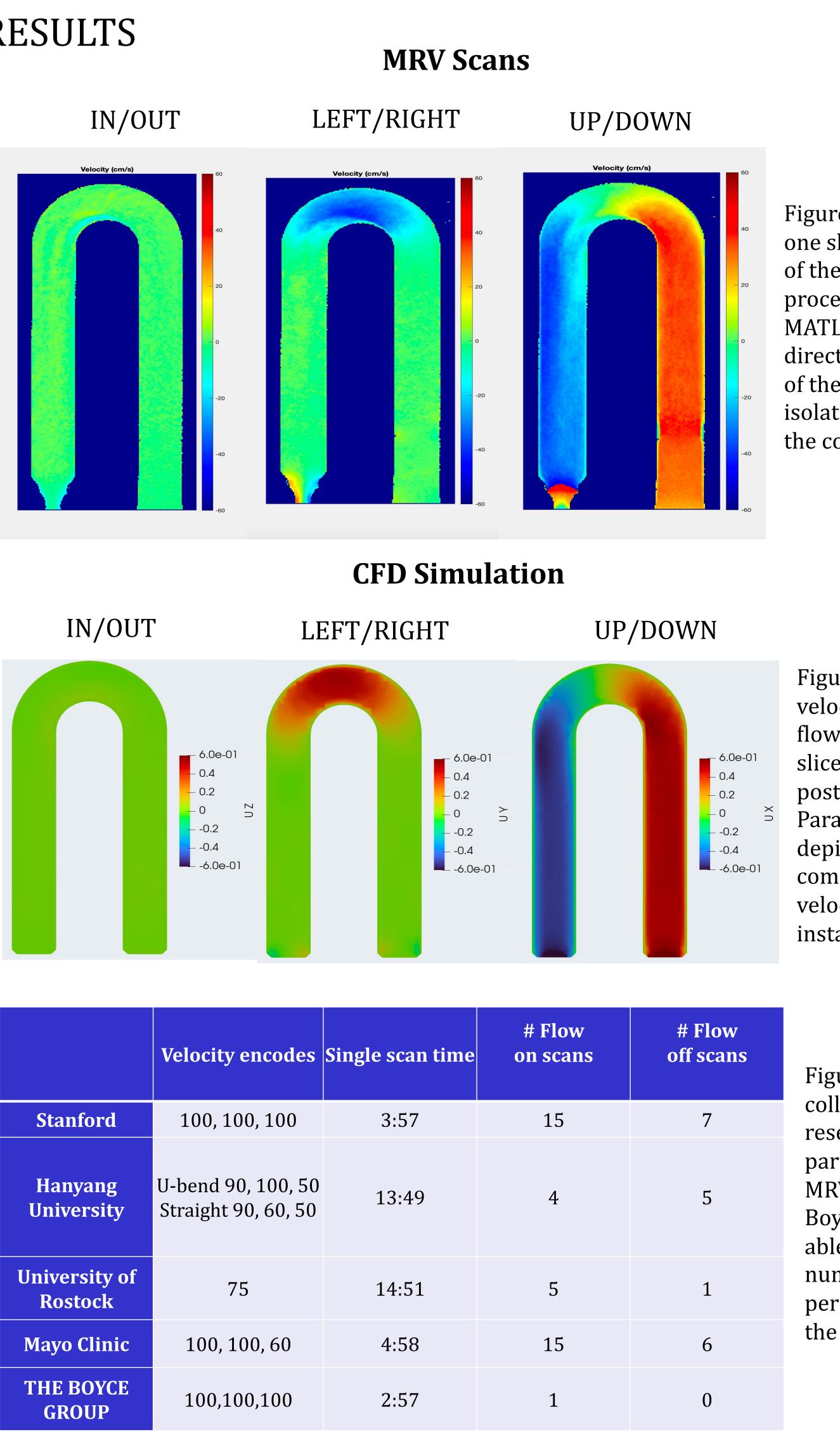
INTRODUCTION

Motivation:
➤ To obtain an understanding of the accuracy of MRV as a method for measuring fluid flow
➤ To identify the most efficient approach to post-process MRV data
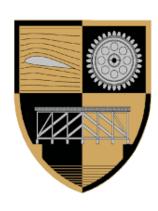➤ To compare experimental MR data to simulated CFD data and identify the errors and oversights of each method

METHODS

EXPERIMENTAL

SIMULATION

RESULTS

MRV Scans

IN/OUT   LEFT/RIGHT   UP/DOWN

Figure 1: MRV scan of one slice of the center of the U-bend, post processed using MATLAB. Each directional component of the velocity was isolated in respect to the coronal plane.

CFD Simulation

IN/OUT   LEFT/RIGHT   UP/DOWN

Figure 2: OpenFOAM velocity scans of fluid flow through one slice of the U-bend, post processed using Paraview. Each scan depicts the three components of the velocity at the same instant in time.

	Velocity encodes	Single scan time	# Flow on scans	# Flow off scans
Stanford	100, 100, 100	3:57	15	7
Hanyang University	U-bend 90, 100, 50 Straight 90, 60, 50	13:49	4	5
University of Rostock	75	14:51	5	1
Mayo Clinic	100, 100, 60	4:58	15	6
THE BOYCE GROUP	100,100,100	2:57	1	0

Figure 3: Data collected by the five research groups that participated in the MRV challenge. The Boyce group was able to reduce the number of scans performed as well as the time per scan

CONCLUSION

➤ Due to novel post-processing methods and MR scanner technology, we were able to more efficiently obtain MRV data through an identical system as the four other participating research groups, without compromising accuracy

FUTURE STUDY

➤ Further data might be obtained by converting Paraview data into a MR simulation using JEMRIS software to provide a more comprehensive comparison to MRV data
➤ MRV scans could be further post processed by using MATLAB to create an average of each slice using the 5 total collected flow-on scans

ACKNOWLEDGEMENTS

REFERENCES

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