Overcoming Image Registration Limitations In Digital Subtraction Angiography with Machine Learning

Brendan T. Crabb, Frederic Noo, PhD, and Gabriel C. Fine, MD

Department of Radiology and Imaging Sciences, University of Utah School of Medicine

U HEALTH UNIVERSITY OF UTAH

HUNTSMAN CANCER INSTITUTE UNIVERSITY OF UTAH

RSNA Radiological Society of North America

UCAIR UTAH CENTER FOR ADVANCED IMAGING RESEARCH

Key Findings

Artifacts due to patient motion can be reliably corrected in visceral angiograms using our technique. Furthermore, no manual input is required and each 512 x 512 pixel image is processed in less than 0.1 seconds, making the clinical application of this technology feasible.

Introduction

Patient motion in digital subtraction angiography (DSA) can render background subtraction difficult, limiting the images' diagnostic quality[1]. As a result, the procedure is often repeated leading to increased healthcare costs, procedure times, radiation dose, and contrast use[2-4]. The purpose of this project is to develop a reliable motion correction technique for catheter angiography using machine learning.

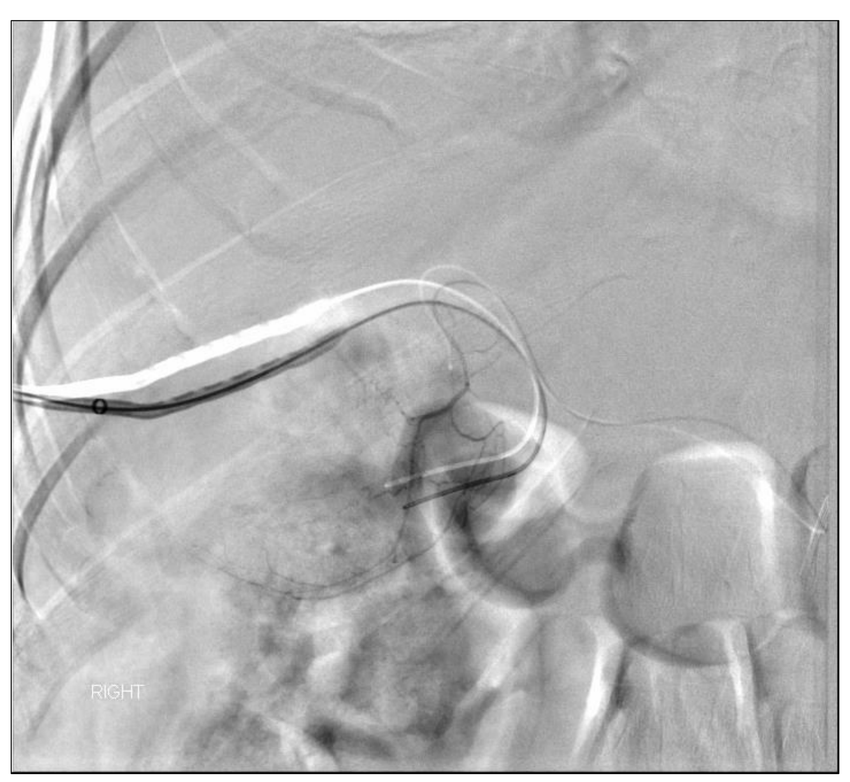

Figure 1. Patient motion creates artifacts in the resultant digital subtraction angiograms, limiting their diagnostic utility.

Methods

The Technology & Venture Commercialization Department at the University of Utah has asked that we do not share technical details regarding our research at this time. If you would like more information, please contact the primary author and we will provide you with a complete description of our methods when possible.

References

1. Meijering, E. H., et. al. (1999). *IEEE Transactions on Medical Imaging*, 18(1), 2-21
2. Harrington, D. P., et. al. (1982). *American Journal of roentgenology*, 139(4), 781-786.
3. Levin, D. C., et. al. (1984). *American journal of roentgenology*, 143(3), 447-454.
4. Pickens, D. R., et. al. (1987). *Medical physics*, 14(1), 56-61.

Results

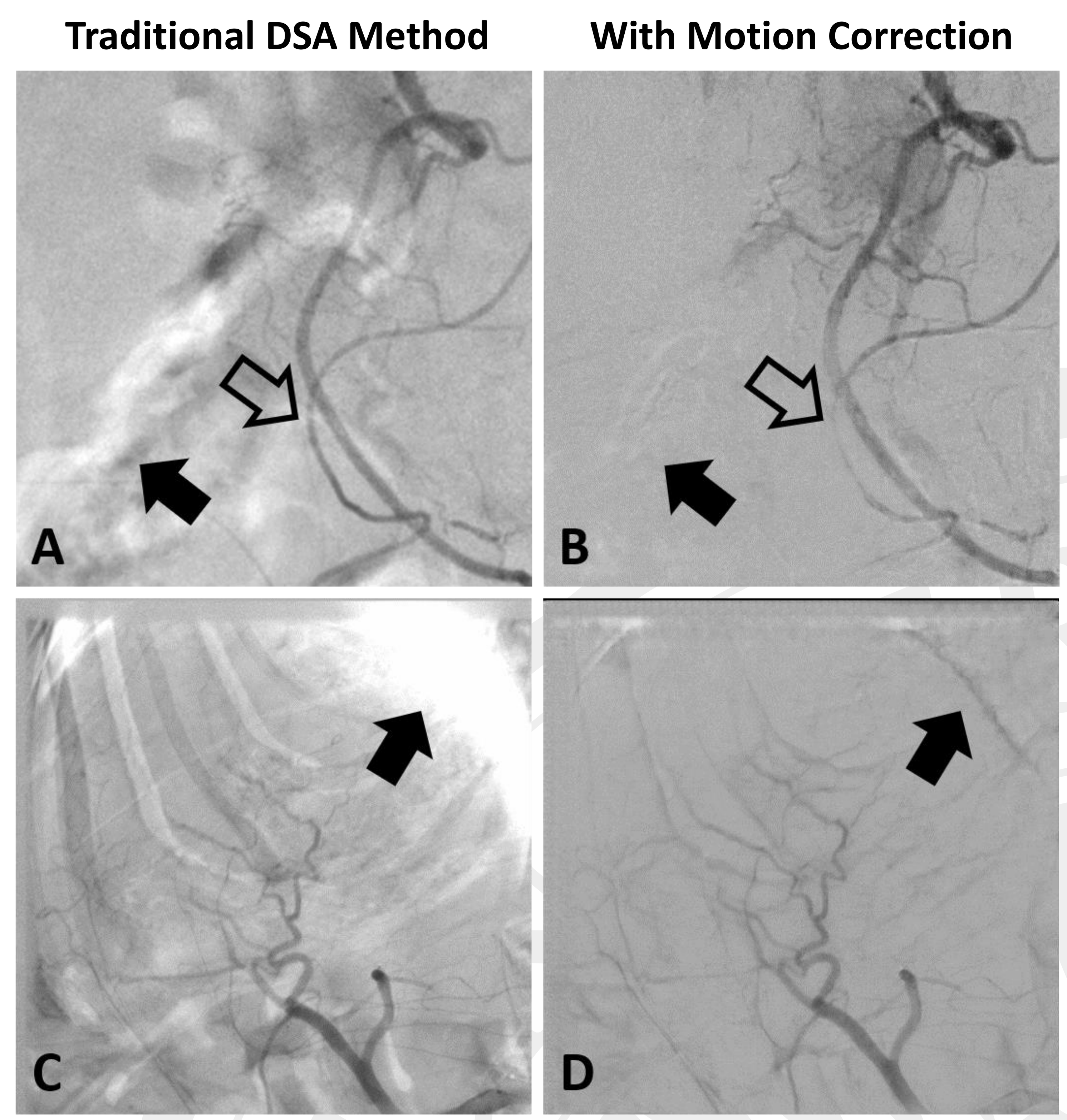

Figure 2. Images A and C: The DSAs created using the traditional subtraction method. **Images B and D:** The DSAs created using our motion correction technique. Motion artifacts present in the traditional DSAs are entirely removed (solid arrows); however, in some instances, the vasculature present in the original DSAs can be faded or obscured by our method (arrow outlines).

Discussion

As shown in in figure 2, motion artifacts present in the traditional DSA image can be reliably removed using our method . Furthermore, this processing can be applied in real-time. Although several challenges still persist, this technology already has the potential to play a role as a non-diagnostic tool for angiographers in settings of significant motion artifacts.

Acknowledgements

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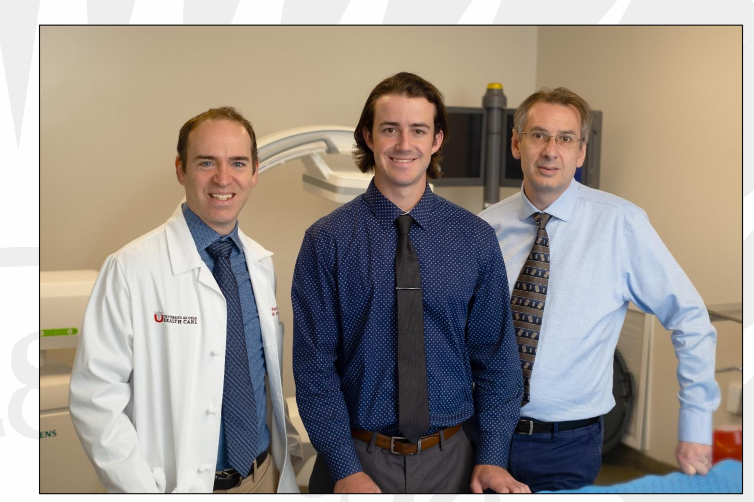
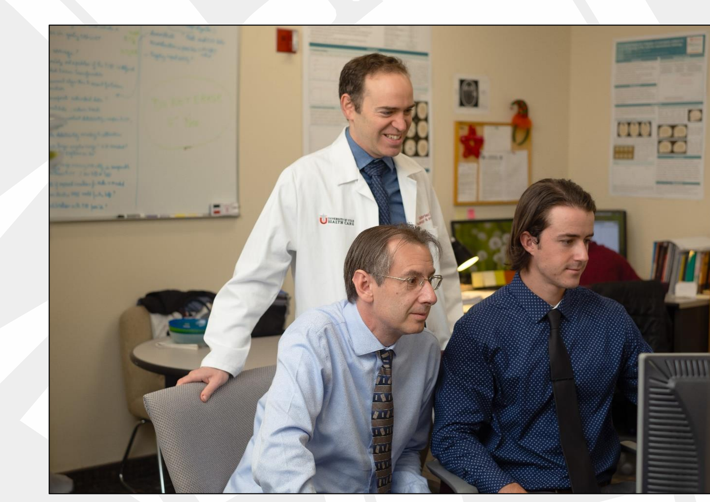
This ongoing project was supported and funded by a generous RSNA Research and Education Foundation grant, which provides current medical students an opportunity to gain critical research experience in academic radiology before applying to residency.

The RSNA medical student research grant enabled me to pursue research that was clinically relevant, personally interesting, and beneficial for my long-term career goals. Through this program, I was able to gain critical skills in the areas of computer programing and machine learning while simultaneously learning about several of the clinical problems faced by physicians in interventional radiology (IR). As a result, this program furthered my passion for IR as a specialty and career.





Career Impact and Future Goals

The medical field critically needs physicians who understand the abilities and limitations of machine learning applications. I would like to thank the RSNA for being willing to support individuals and institutions such as myself who are attempting to address this need. With the help of the medical student research grant, I was able to gain technical expertise and experience in the application of machine learning to the medical field. As my career progresses, I hope to continue building on this foundation and perform additional research in this domain.