Research Promises: Advanced Acceleration Methods, Cardiac Gated MRA

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Highlights

With utility of novel contrast agents and advanced image acceleration methods, MR angiography is undergoing a paradigm change.

Target Audience

Scientists and clinicians with basic to intermediate knowledge of cardiovascular MRI who are interested in learning latest advances in MR Angiography and acceleration methods.

Introduction

The purpose of this lecture is to introduce the basic principles of contrast-enhanced and non-contrast MR angiography. Traditional contrast-enhanced MRA uses gadolinium as MR contrast agent and is typically performed during a 20-25 second breath-hold due to the need to capture the first-pass of the contrast agent as well as for respiratory motion compensation. As a result, such acquisitions are not gated to ECG and consequently traditional CE-MRA provides excellent definition of extra-cardiac structures, but intra-cardiac structures are subject to cardiac motion blurring. There has been a recent trend of developing cardiac and/or respiratory motion gated CE-MRA acquisitions during free-breathing. To enable this type of acquisitions, an intravascular contrast agent is required to eliminate the need for capturing the first-pass of contrast agent, and alternative motion compensation techniques are required to replace breath-holding. In addition, advanced image acceleration methods are needed to achieve high quality data set within a reasonable scan time. As a demonstration of clinical utilities of such methods, we will highlight recent literature of using ferumoxytol as an intravascular contrast agent for 4D dynamic cardiac-gated MRA applications in pediatric congenital heart disease patients. Pulse sequence implementation details as well as a custom image reconstruction system will be described. A combined parallel imaging and compressed sensing image reconstruction algorithm that is applied to these 4D dynamic MRA data sets will be described. Practical issues regarding typical image artifacts associated with CS reconstruction, image reconstruction time will also be discussed. By the end of the lecture, the audience should be able to obtain a basic and intuitive understanding of the basic principles of MRA, how CS reconstruction works, the current state of the art in this field, and practical issues regarding implementations.

References

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