# Application of Fast Imaging Techniques: Compressed Sensing

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**Highlights:**
Compressed Sensing (CS) is an emerging technique that has great potential in cardiovascular MRI

**Target Audience:**
Scientists and clinicians with basic knowledge of cardiovascular MRI who either conduct research to accelerate cardiovascular MRI applications or are interested in learning about potential benefits to use CS.

**Introduction:**
The purpose of this lecture is to introduce the basic principles of CS MRI techniques with a focus on various cardiovascular MRI applications. CS assures accurate reconstruction of MR images from a reduced set of acquired k-space data, and three key components (sparsity, incoherence, and non-linear reconstruction) that ensure a successful CS-MRI reconstruction will be firstly discussed in details.

Secondly, practical and fundamental issues associated with CS, depending on implementation and applications, will be discussed:

- Image artifacts: residual artifacts are often hard to distinguish from true signal by the nature of incoherence. In contrast, residual aliasing from parallel imaging can sometimes be more easily spotted (i.e. coherent artifacts).

- Combination of other image reconstruction methods: Integration of other reconstruction methods such as parallel imaging is technically challenging. CS uses the sparsity to find a solution while parallel imaging finds a solution by either explicitly or implicitly exploiting knowledge of coil sensitivity information. Sometimes, this can be contradictory in both sampling trajectories and reconstruction.

- Other practical challenges include 1) the optimal choice of the regularization parameters, and 2) the high computational complexity, which often makes the reconstruction time too long.

Lastly, recent works in the areas of applying CS to MR angiography, coronary imaging, cardiac cine MRI, and myocardial viability imaging will be reviewed.

In summary, CS holds tremendous potential in many cardiovascular MRI applications because of its multi-dimensional nature, excellent sparsity and substantial information redundancy. By the end of the lecture, the audience should be able to obtain a basic and intuitive understanding of CS MRI techniques, practical issues associated with CS, and the current state of the art in this field.

**References:**

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