Title **Temporal acceleration methods**

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Highlights

- Temporal acceleration improves the scan performance of cardiovascular MRI significantly, from several fold to several orders of magnitude
- Temporal acceleration is at a stage of fast growth, with the proliferation of many new techniques
- Existing and emerging techniques are used across diverse applications, from cardiac function, perfusion, flow, to angiography

Target audience Practitioners and students of cardiovascular MRI with an interest in existing and emerging techniques for scan acceleration

Objective The audience will learn the key concepts, approaches, and impact of temporal acceleration across major cardiovascular MRI applications

SUMMARY:

Temporal acceleration (1) is an increasingly important and widely adopted approach to address the stringent speed requirements of cardiovascular MRI across diverse applications (e.g. cardiac function, perfusion, flow, angiography). Temporal acceleration speeds up a dynamic scan by undersampling temporally (i.e. skipping at each time frame some data that are normally acquired), and recovering the data afterwards during reconstruction. The recovery is based on the observation that the images in a time series are similar across time frames. There are generally two types of data recovery:

- **Fixed recovery** encompasses techniques such as view sharing (2), keyhole (3), TRICKS (4), UNFOLD (5), and TSENSE (6). These techniques make *a priori* assumptions how the missing data can be recovered from the acquired ones. This can be as simple as copying data from one time frame to another, assuming that the data do not vary greatly across time frames. Alternatively, it can involve interpolation or filtering to fill in missing information. In all cases, the recovery technique is based on assumptions of the user, rather than derived from the data

- **Data-adaptive recovery** encompasses techniques such as compressed sensing (7-10), *k-t* approaches and variants (11-13), HYPR (14), and Kalman filtering (15). These techniques learn at least one of the following from the undersampled data: the degrees of freedom and the model needed to represent the data. This learning or adaptive capability can be achieved through optimization (Kalman filtering and compressed sensing) or imaging of the required information (*k-t* BLAST, HYPR, separable functions)

Recent activities in this area have placed an increasing emphasis towards data-adaptive recovery. Examples of temporal acceleration will be shown from several applications, highlighting the performance gain from several fold to several orders of magnitude.

References

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