

# MR ANGIOGRAPHY ACCELERATION TECHNIQUES WITH ITERATIVE RECONSTRUCTIONS: THE IT-TWIST SEQUENCE

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## ABSTRACT

*In recent years MR Angiography allowed to assess blood vessels and flow in a non-invasive way. The aim of our work was to illustrate a modern MR Angiography technique, the 4D Iterative reconstruction Time resolved angiography With Interleaved Stochastic Trajectories (IT-TWIST), capable to generate angiograms with high spatial and temporal resolution, providing multiple and continuous post-contrastographic sets of images. Technological and physical characteristics are reported in detail and consequent advantages are summarized.*

## INTRODUCTION

MR Angiography is an imaging method that allows an accurate and non-invasive assessment of blood flow and blood vessel morphology. The sequences used in recent years have undergone considerable modifications with the aim of improving not only the temporal resolution, which is fundamental for angiographic imaging in MRI, but also to give a significant response in terms of spatial resolution.

## PURPOSE

MR angiography techniques are increasingly required to replace or in addition to the conventional methods used until now. The aim of this study is to present the new method 4D Iterative reconstruction Time resolved angiography With Interleaved Stochastic Trajectories (IT-TWIST) designed to provide angiograms with high spatial resolution by applying algorithms that allow to obtain multiple and continuous sets of images.

## MATERIAL AND METHODS

After an analysis of data published in literature, technological and physical characteristics, and consequent advantages of the Angio-RM 4D Time Resolved technique and its most recent combination with iterative reconstructions, are reported and summarized in detail.

## RESULTS AND DISCUSSION

Among the various techniques applied in MR-Angiography the 4D Time Resolved are currently those that provide static images with high quality and high temporal resolution, able to document the dynamism of post-contrast phases. The Iterative reconstruction Time resolved angiography With Interleaved Stochastic Trajectories It-TWIST is a sequence that combines parallel imaging techniques and efficient subsampling methods with the iterative data reconstruction system.

The technology is based on a sequence Rapid Acquisition GRE-Pulse Fid-Imaging Spoiled T1w with very short TR (2-3ms), short TE (1-2 ms) and an FA ranging between 15- 25- compete with a broad bandwidth and a view-sharing sampling combined with “Key-hole” method in which the K-space is divided into two parts: a central region A and a peripheral region B, the latter divided into random sub-regions “b1-b2-b3...”

After contrast medium administration, the images are acquired in several consecutive stages. In particular, the data of central region A, that carry informations about the contrast of the image, are acquired completely and continuously, in association with the data of sub-regions “b” which are alternatively and stochastically acquired at each stage, and which carry informations related to spatial resolution.

Iterative Reconstruction is then applied to each cycle, i.e., a collection of region A data is created together with the raw data iteratively reconstructed in sub-region “b” and data-matching of the other sub-regions b, stochastically obtained in the various stages. This operation continues until the ideal condition obtained through a comprehensive research of parameters in the space is met, thus applying a data loop on several steps, refining and improving the result thanks to a cost function that guides the mathematical relationship with its own ratio accuracy/ speed of search.

Although in MR Imaging a compromise between Time Resolution and image quality exists, IT-TWIST seems to resolve both conditions. The implementation of Iterative Reconstruction applied to the sequence 4D Time resolved angiography With Interleaved Stochastic Trajectories effectively contributes to the “denoising” of images thanks to the greater robustness provided by the convolution of data, providing a higher degree of images quality than conventional Contrast Enhanced MR-Angiography and an optimal contrast-enhancement intensity between the various phases, with a finer and detailed delineation of the main artero-venous and secondary branches.

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