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# Investigating Respiratory Motion Artefacts and ROPE in Magnetic Resonance Spectroscopy

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## Abstract

This research paper presents the problem of respiratory motion and the associated artefacts in Magnetic Resonance Spectroscopy. The nature and the appearance of respiratory motion artefacts, already extensively investigated in conventional 2D Fourier transform Magnetic Resonance Imaging, is studied in combination with the possibility of using the ROPE (Respiratory Ordered Phase Encoding) method to reduce such artefacts. In particular the study is focused on spectroscopic CSI and processing of the data is done by using the autocorrelation function.

This paper is given as originally presented, in the form of scientific poster at the SMRM 12th Annual Meeting, New York 14-27, August, 199 , with the title: "An Investigation of motion artefact in spectroscopic CSI" by T. N. Arvanitis, D. J. Bryant<sup>1</sup>, A. G. Collins<sup>1</sup>, G. A. Coutts<sup>1</sup>, and A. S. Hall<sup>1</sup>. (The original abstract can be found in the Proceedings of the SMRM 12th Annual Scientific Meeting, August 199 , volume 2, p909).

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## Introduction

The appearance of artefacts due to physiological motion is commonly recognized in conventional 2D Fourier transform imaging. Motion introduces signal modulation resulting in displaced “ghost-like” artefacts and an overall degradation of image quality.

The development of multi-dimensional spectroscopic chemical shift imaging (CSI) has particularly emphasized the degree of spatial localization. However, despite its applications to hepatic and cardiac spectroscopy, the relevance of movement upon CSI has not been fully investigated.

## Aim of the Study

In this work, we investigate the effects of physiological motion upon spectroscopic CSI data, as well as the possibilities of correcting these effects by using ordered phase encoding techniques for the acquisition of the data. In particular, we investigate the application of the Respiratory Ordered Phase Encoding (ROPE) method [1] to the acquisition of CSI data.

Furthermore, we use the autocorrelation function of the spectroscopic data as an attempt to specify a standard approach to the quantification of the relative contributions of ghosting and noise, in order to assess improvements in motion artefact control.

## Materials and Methods

All experimental work was carried out on a Picker prototype MRS system, operating at a field strength of 1.5 Tesla. Enveloping transmitter coils were employed in order to generate homogeneous excitation fields. Surface receiver coils were employed to improve sensitivity. The overall configuration represents one of the standard protocols for our

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For the implementation of ROPE, the motion waveform was digitized

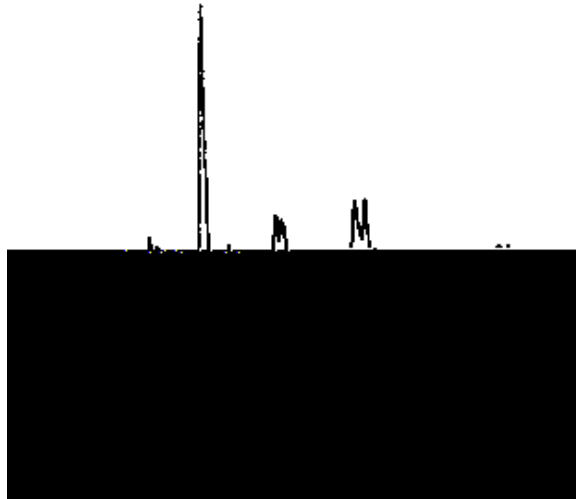


Figure 1: Non-ROPE  $^{31}\text{P}$  cardiac spectrum

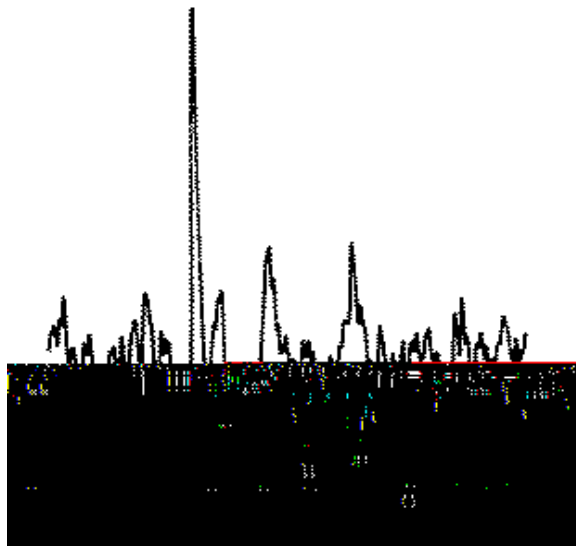


Figure 2:  $^{31}\text{P}$  cardiac spectrum with ROPE applied

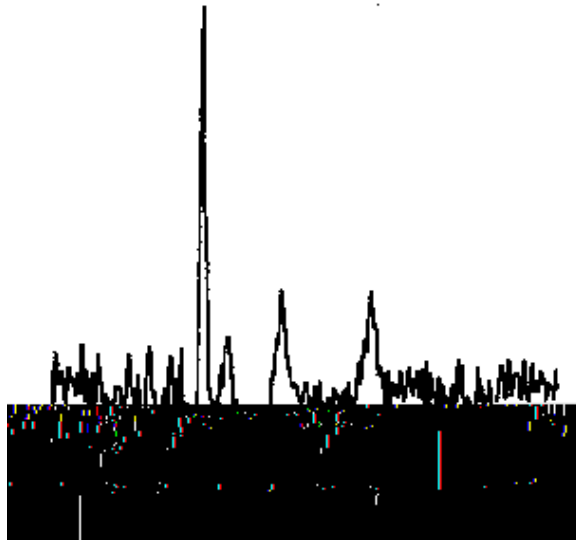


Figure :  $^{31}\text{P}$  hepatic, non-ROPE MRS spectrum - surface plane

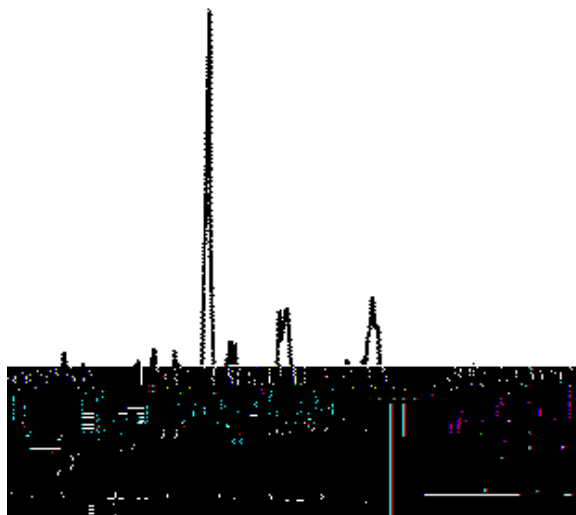


Figure 4:  $^{31}\text{P}$  hepatic study with ROPE acquisition - surface plane



Figure 5: MR image of stationary phantom

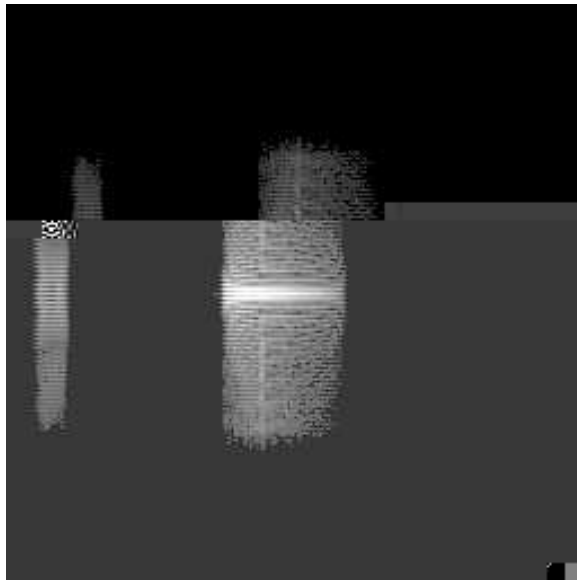


Figure 6: Autocorrelation in phase encode direction of stationary object

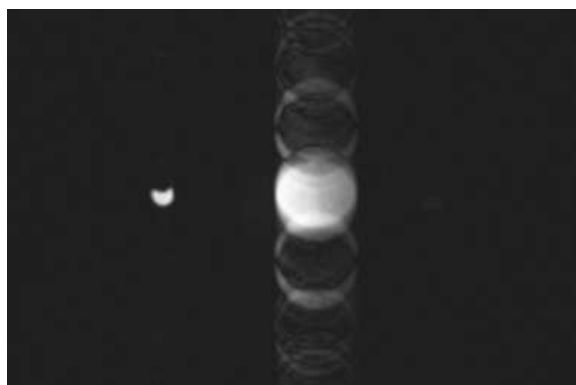


Figure 7: MR image of moving phantom

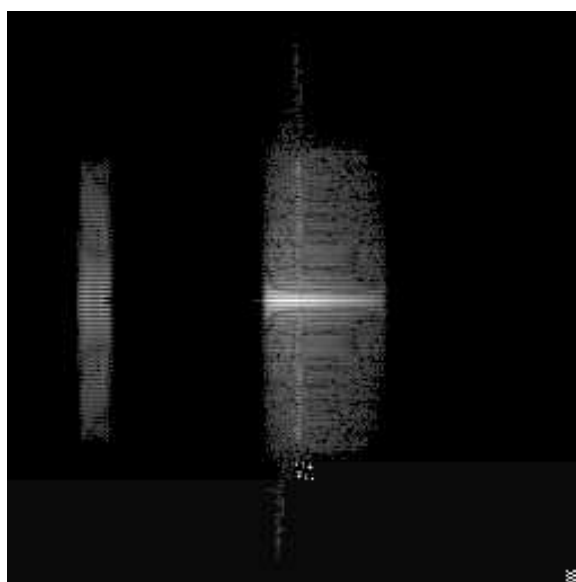


Figure 8: Autocorrelation in phase direction of moving object



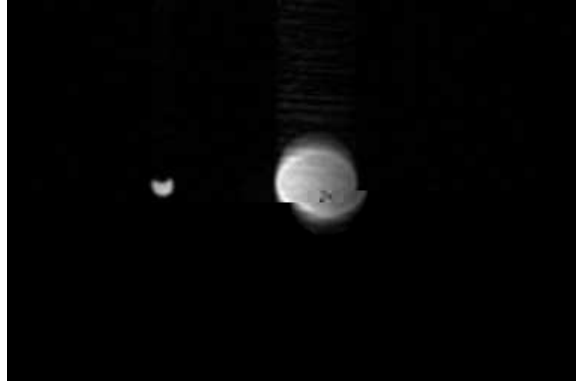


Figure 9: MR image of moving phantom with ROPE acquisition

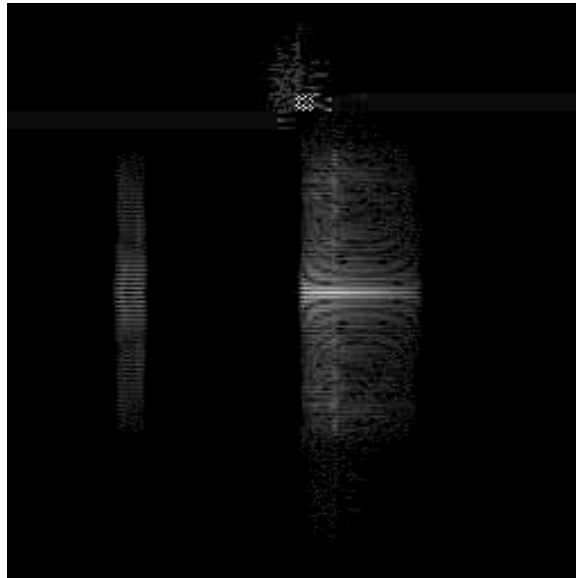


Figure 10: Autocorrelation function in phase encode direction for moving object with ROPE acquisition

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