Livertool: an Open-source Tool for Liver Fat Fraction Estimation with Magnetic Resonance Images

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INTRODUCTION

The presence of fat in liver tissue, also known as hepatic steatosis, is a pathogenic abnormality found in up to 30% of the US population. Amongst noninvasive quantitative approaches, magnetic resonance imaging (MRI) has shown great relation to biopsy, the current gold standard. Hepatic steatosis quantification in MRI is accomplished in terms of liver fat fraction (FF) estimation and current methods rely on voxel signal behavior in so-called in-phase and opposed-phase (IP/OP) images. In this context, FF represents the relation of fat to water proton densities in a studied volume. Despite the algorithms being available in scientific community, researchers and test centers willing to adhere to this imaging estimation method must either perform calculations on their own or use proprietary software developed by their MR scanner manufacturer, when available. The objective of this work is to introduce an alternative open-source tool for liver fat fraction estimation using magnitude IP/OP MR images.

MATERIALS AND METHODS

The tool was designed and implemented in MATLAB R2015a 64-bit (Mathworks, Natick, USA). Two stable approaches were used for FF estimation, according to the number of echoes available per slice: classical dual-echo, an algebraic solution as proposed by Dixon [1], which requires two echoes and multi-interference [2], a nonlinear least squares solution using three or more available echoes. Those algorithms have been validated in literature and their implementation in the tool are currently under validation.

RESULTS

An image of the tool's graphical user interface displaying an MR test with two regions of interest (ROI) and results is shown in Figure 1. Main features include: separate slice and echo navigation bar, especially useful for IP/OP images; ROI drawing tool in various shapes; signal intensity plot over echo times and tables with copyable results per region of interest calculated.

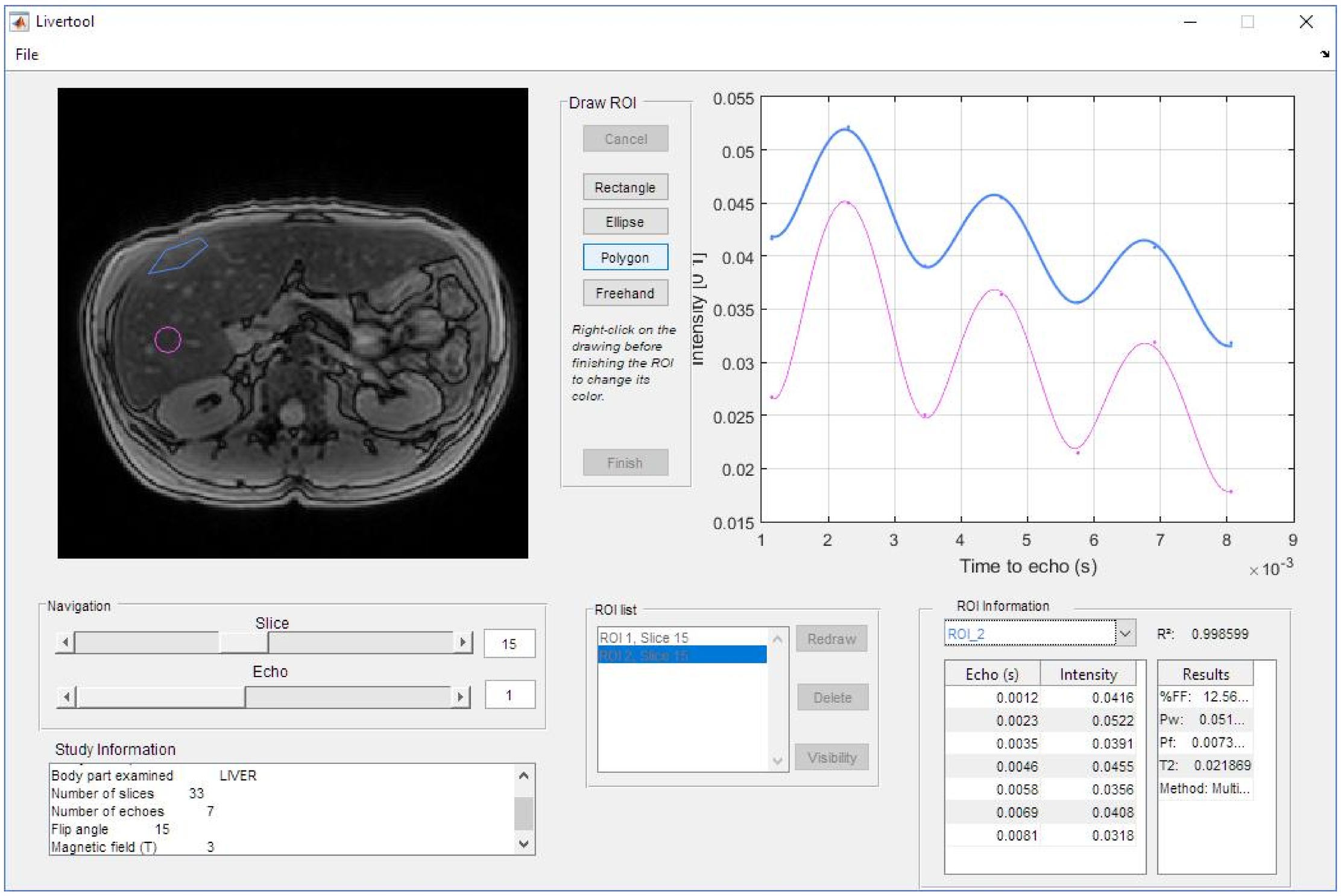

Fig. 1: Graphical user interface of the tool.

DISCUSSION AND CONCLUSION

An open-source tool for estimation of hepatic fat fraction using MR images was presented. It is based on reliable classical and cutting-edge fat fraction estimation methods. Current development efforts are towards generating FF maps and exporting results as DICOM files. Preliminary tests were performed using the tool to estimate FF with methods described in literature and validated based on biopsy values. The project is an alternative to other manufacturer-dependent software and is open to contributions, available at *https://github.com/livertools/livertool*.

REFERENCES

[1]Dixon, WT. Simple proton spectroscopic imaging. Radiology, v. 153, n. 1, 189–94, 10 1984. [2]Yokoo T. et al. Nonalcoholic fatty liver disease: diagnostic and fat-grading accuracy of low-flip-angle multiecho gradient-recalled-echo MR imaging at 1.5 T. Radiology, v.251, n. 1, 67–76,2009.

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