This Article of the month: "Evaluating Quantitative Proton-Density-Mapping Methods" (PDF) is the work of Aviv Mezer, Ariel Rokem, Shai Berman, Trevor Hastie, and Brian A. Wandell.

Magnetic resonance imaging (MRI) is a critical tool for assessing live-human-brain structure and function. However, most MRI measures are limited to relative or qualitative assessment based on image intensities with arbitrary units. The lack of physical units limits the applicability of the data; without units, scientists and clinicians cannot meaningfully compare images obtained at different MR sites, or even from the same individual at different points in time. Proton density (PD) is the most basic brain-tissue property that can be measured with MRI, and it is critical for understanding structural variation between individuals, measured with MRI. In the present publication, Aviv Mezer and Shai Berman, together with researchers from Stanford University and the University of Washington, test the ability to quantify PD and separate it from the instrumental bias.

The article provides a rigorous foundation and evaluation of several different techniques that solve the quantification problem. In addition to explaining the theory, we provide full software implementations that both simulate and analyze how to quantify the MRI signal.

The article shows that the best results are obtained using a novel regularization approach that incorporates an additional T1 measurement. This study is the first theoretical evaluation of quantitative-PD and coil-sensitivity estimation from MRI data. With the paper, the authors also provide the data and software algorithms needed to replicate the findings and figures.

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