

IN VIVO TEMPERATURE BRAIN MAP USING jMRUI v4.x: A PLUGIN DEVELOPMENT

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Introduction: The knowledge of brain temperature has acquired clinical importance because of recent interest in the relationship between inflammation, raised temperature and neurological outcome following conditions such as stroke and traumatic injury as well as the potential benefits of therapeutic hypothermia for neuroprotection.

Magnetic resonance spectroscopy can provide a non-invasive approach to measure the internal temperature of the brain; it relies on the linear relationship between the ¹H MR resonance frequency of water in the tissue and the tissue's temperature. The absolute temperature is obtained by measuring the chemical shift of water relative to a reference compound such as N-Acetylaspartate (NAA). To convert the frequency difference between these two signals into temperature, it is necessary to apply a calibration curve [1].

All these procedures could be performed using a plugin of jMRUI, a Java-based Graphical User Interface that allows time-domains analysis of MRS, MRSI and HRMS-NMR signals[2].

In this work we used jMRUI v4.x, a new version of the software that enabled the user to add their own plugin.

Procedure: Spectra coming from the scanner are analysed using jMrui, with the quantitation algorithm AMARES the frequencies of water and NAA peaks are measured. The temperature plugin reads the frequency of water and NAA and calculates the differences Δ . This Δ is inserted in a suitable formula that estimates the temperature. After temperature estimation, the MRSI mode of the plugin produces a colour-coded map of the temperature and superimposes it on the corresponding MR image (see Fig. 1).

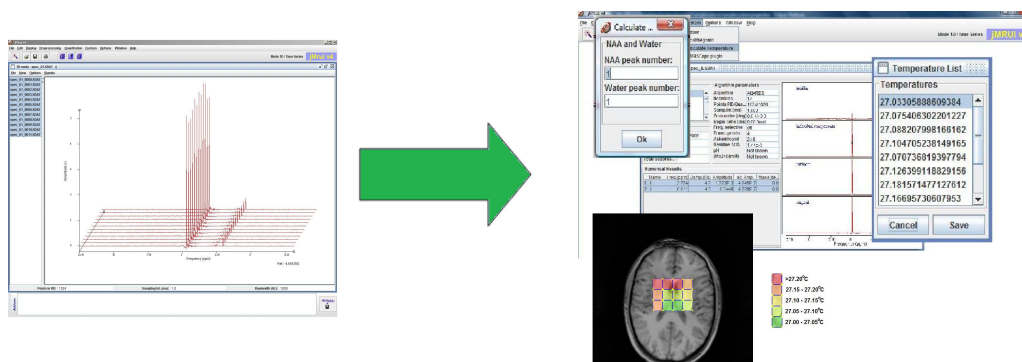


Fig. 1. Scheme of the plugin method to estimate and map brain temperature. On the left the spectra coming from the scanner are shown; on the right the screen result, together with the map are shown.

Conclusion: NMR brain temperature could provide useful information for many thermal therapies such as hypo/hyperthermia and it could give us useful diagnostic information. The use of the jMRUI plugin automates and speeds up the procedure to obtain temperature maps and this could be incorporated as a tool to be used in real-time interventional MRI in the clinic and during surgery.

Acknowledgment: FAST, Advanced Signal-Processing for Ultra-Fast Magnetic Resonance, and Training, (MRTN-CT-2006-035801). Marie Curie Action.

References:

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