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# Optimization and enhancement of CNR in MRI using core/shell contrast agent

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Title:
Optimization and enhancement of CNR in MRI using core/shell contrast agent

D. MacDonald [1], B. Blasiak [1] [2], B. Tomanek [1] [2] [3]

Presenting author:
David MacDonald
dmlmacdona@gmail.com

Magnetic resonance imaging (MRI) provides the best soft contrast tissue among diagnostic imaging modalities such as CT, PET or X-ray. The contrast provided by MRI is based on the proton density and on interactions of protons with the surrounding molecules of tissues causing so called T_1 and T_2 relaxations. MRI techniques utilize these processes for contrast manipulation by producing T_1 or T_2 weighted MR images. While MRI contrast may be provided solely by tissues themselves due to differences in their relaxation times, contrast agents shortening T_1 and T_2 further improve detection of small pathologies such as early stages breast or brain cancers. Recently T_1/T_2 core shell contrast agents have been developed with an expectation that the contrast to noise ratio (CNR) would be greater than when compared to T_2 contrast agent. To prove this, firstly we calculated optimal parameters in commonly used Spin Echo and IR TrueFISP pulse sequences that provide the greatest CNR for known T_1 and T_2 relaxation times for an animal model of breast cancer. The results show that the CNR of a tumor for a T_1/T_2 core shell contrast agent is greater than that of just a T_2 contrast agent for both the Spin Echo and IR TrueFISP pulse sequences. To demonstrate the potential of our core/shell contrast agent in vivo MRI we imaged mice with breast tumors after intravenous injection of 0.25 mL of non-targeted core shell contrast agent NaDyF4 (20 nm)/NaGdF4 (~ 0.5 nm). Then to further increase the CNR, we subtracted a T_1 weighted image with T_2 weighted image. Post-injection results show that the best CNR comes from the T_1 weighted image subtracted by the T_2 weighted image, and the CNR for the T_1 weighted image is greater than the CNR for the T_2 weighted image.

[1] Instytut Fizyki Jadrowej Polish Academy of Science, Waleregо Eljasza Radzikowskiego 152, 31-342 Kraków, Poland
[2] University of Alberta, 116 St & 85 Ave, Edmonton, AB T6G 2R3, Canada
[3] University of Calgary, 2500 University Dr NW, Calgary, AB T2N 1N4, Canada

**Primary author:** MACDONALD, David

**Co-authors:** BLASIAK, Barbara; Mr TOMANEK, Boguslaw (Main Supervisor)

**Presenter:** MACDONALD, David

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