# INTRODUCTION

The key of any neurosurgical treatment of brain tumors is to maximize the resection of the tumor tissue and in the same time to minimize the resection of adjacent normal brain tissue. ***(Faro, S. H. and Mohamed, F. B.; 2006)***

Blood oxygen level-dependant functional MR imaging (BOLD fMRI) has been proved to be a clinically successful method for preoperative mapping of eloquent brain tissue. ***(Haberg, A. et al.; 2004)***

The way BOLD fMRI constructs functional images is done by exploiting the susceptibility produced by the paramagnetic nature of deoxyhemoglobin (deoxy-Hb). ***(Baudelet, C. and Gallez, B.; 2002)***

Oxyhemoglobin has diamagnetic nature, therefor, it can be differentiated from deoxyhemoglobin of paramagnetic nature. ***(Pauling, L. and Coryell, C. D.; 2006)***

When nerve cells of eloquent brain tissue perform specific functional tasks, they increase their consumption of oxygen, switching to less energetically effective, but more rapid anaerobic glycolysis. The local response to this oxygen utilization is to increase blood flow to those regions of increased neural activity which occurs after a delay of approximately 1:5 seconds. This hemodynamic response rises to a peak over 4:5 seconds, before falling back to baseline. This leads to local changes in the relative concentration of oxyhemoglobin and deoxyhemoglobin and changes in local cerebral blood volume, in addition, a change in local cerebral blood flow. ***(Raichle, M. E. and Mintun, M. A.; 2006)***

The magnetic resonance (MR) signal of blood is slightly different depending on the level of oxygenation. Higher BOLD signal intensities arise from increases in the concentration of

oxygenated hemoglobin since the blood magnetic susceptibility now more closely matches the tissue magnetic susceptibility. ***(Zwaag, W. et al.; 2009)***

By collecting data in an MRI scanner with sequence parameters sensitive to changes in magnetic susceptibility, one can assess changes in BOLD contrast which can be either positive or negative depending on the relative changes in both cerebral blood flow (CBF) and oxygen consumption. ***(Logothetis, N. K. and Pfeufer, J.; 2004)***

The signal difference is very small, but given many repetitions of a thought, action or experience, statistical methods can be used to determine the areas of the brain which reliably show more of this difference as a result, and therefore which areas of the brain are active during that thought, action or experience. ***(Kwong, K. K. et al.; 1992)***

Using BOLD fMRI in cases of brain tumors can facilitate planning for surgeries, shorten the operation and anesthesia time, enables surgeons to awaken the patients during the operations for motor and language evaluation, and hence, enhance the outcome of the neurosurgical treatment. ***(Jay, J. P. et al.; 2004)***