# Estimating relapse risks for glioblastomas with Level-set and Machine Learning methods.

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Glioblastomas are the most aggressive form of brain cancer. They are associated with a very bad prognosis and an extremly high risk of relapse. In this work, we use data provided by the STEMRI cohort in order to develop mathematical models and numerical methods to estimate the relapse speed of the patients.
The usual treatment for glioblastomas involves surgery followed by temozolomide associated to radiotherapy. In [1], it is shown that MRI data of the postoperative cavity can bring informations on the risk of relapse of the patient. Hence we choose to focus on the study of the postoperative cavity and the computing of quantitative informations in order to help clinicians in the decision process.
First, we propose a mechanistic model for the postoperative cavity resorption that can be calibrated using volume informations provided by MRI. This model is based on a Darcy law coupled with conservation equations. For the numerical simulations we used Finite Volume schemes on a Level-set formulation of the model. An integrated version of the model can be used to estimate the resorption speed of the cavity which is shown to be a prognosis indicator.
The enhancing diameter on MRI data is already known to be another prognosis indicator but there is a lack of quantitative computation for this parameter. Based on a Fast Marching algorithm, we propose an efficient numerical methods to compute the enhancing diameter.
Combining those two parameters, we propose a classification of the patients using Machine Learning methods depending on their relapse speed. We show then that those indicators can actually be used in clinical application to evaluate the relapse risk of the patients.

### Références

[1] G-M Quan, Y-L Zheng, T. Yuan and J-M Lei, *Increasing FLAIR signal intensity in the post-operative cavity predicts progression in gross-total resected high-grade gliomas*, Journal of Neuro Oncology, 2018.

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