# Peak of the Iceberg

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## The research story

Medical imaging plays a central role in cancer therapy, however scans cannot detect the full extent of infiltrative brain tumors. Post-mortem and histological studies show that tumor cells can be found even 2 cm beyond the tumor outlines visible on the medical scans. Current radiotherapy planning is handling these uncertainties in a rather rudimentary fashion. The irradiated volume is constructed by extending the tumor regions visible on the medical scans by a uniform margin, neglecting the patient-specific tumor dynamics and brain anatomies. We calibrate a computational tumor growth model using patient-specific structural and metabolic medical scans in a Bayesian inference framework to predict tumor cell infiltrations beyond those visible on the medical images [1]. The model predictions enable personalised radiotherapy designs with improved delineation of tumor regions and identified radio-resistant areas. In turn the ensuring radiotherapy spares healthy tissue and reduces radiation toxicity, while reaching comparable accuracy with standard radiotherapy protocols [1].

## The image

The visualisation shows the outline of a patient tumor visible on the medical scans (orange) together with the outline of the predicted tumour cell infiltration (blue), inside the brain anatomy (white) reconstructed from the patient's medical scans. The visualization is performed using Volume Perception [2], a volume rendering software employing a ray-casting technique. The image components are visualized as translucent isosurfaces obtained by pre-integrated volume rendering. The 3D visualizations enhance our understanding of complex tumor structures, enable the detection of possible tumor cell migration pathways, and assist in clinical decision making.

**References**

[1] Lipkova J, et al., Personalized radiotherapy design for glioblastoma: integrating mathematical tumor models, multimodal scans and Bayesian inference, IEEE transactions on medical imaging, 2019.

[2] Rossinelli D, Multiresolution flow simulations on multi/many-core architectures, PhD thesis, ETH Zurich, 2011.





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