

# Implementation of deep learning algorithm for automatic detection of brain tumors using intraoperative IR-thermal mapping data

A. V. Makarenko <sup>a, b 1</sup>, M. G. Volovik <sup>c, d</sup>

<sup>a</sup> Constructive Cybernetics Research Group  
P.O.Box 560, Moscow, 101000 Russia

<sup>b</sup> Institute of Control Sciences, Russian Academy of Sciences  
ul. Profsoyuznaya 65, Moscow, 117977 Russia

<sup>c</sup> Volga Federal Medical Research Center, Ministry of Health of Russia  
Nizhny Novgorod, Russia

<sup>d</sup> Nizhny Novgorod State Medical Academy  
Nizhny Novgorod, Russia

**Abstract.** The efficiency of deep machine learning for automatic delineation of tumor areas has been demonstrated for intraoperative neuronavigation using active IR-mapping with the use of the cold test. The proposed approach employs a matrix IR-imager to remotely register the space-time distribution of surface temperature pattern, which is determined by the dynamics of local cerebral blood flow. The advantages of this technique are non-invasiveness, zero risks for the health of patients and medical staff, low implementation and operational costs, ease and speed of use. Traditional IR-diagnostic technique has a crucial limitation - it involves a diagnostician who determines the boundaries of tumor areas, which gives rise to considerable uncertainty, which can lead to diagnosis errors that are difficult to control. The current study demonstrates that implementing deep learning algorithms allows to eliminate the explained drawback.

**Keywords:** deep learning, brain tumors, IR-thermal mapping, cold probe, intraoperative navigation.

---

<sup>1</sup>E-mail: avm.science@mail.ru