GlioVision: A Platform for the Automatic Assessment of Glioblastoma Tumor Features, Molecular Identity, and Gene Methylation from Histopathological Images Using Deep Learning

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Glioblastoma Multiforme (GBM) is one of the most aggressive types of brain cancer, the most common malignant brain tumor amongst adults, and has a mean survival time of 12 months post-diagnosis. While many researchers focused on the diagnosis of GBM, one overlooked area is the post-diagnosis treatment determination. The current treatment pipeline takes several weeks with costly manual tumor feature segmentation, survivorship estimations, and a genetic panel to determine molecular subtype and MGMT promoter methylation, each of which are implicated in chemotherapy effectiveness. Despite the need for an accurate and data-driven approach to extracting tumor information from a single brain biopsy image (WSI) after diagnosis, a solution does not currently exist. This study presents GlioVision, an unprecedented assessment platform that uses state-of-the-art neural networks and a dataset of over 250 WSIs to extract relevant histopathological and genetic information. The networks exhibited 86%, 94%, and 96% testing accuracy for feature segmentation, subtype classification, and MGMT methylation prediction, respectively. To understand the basis of this prediction, 94 textural features were extracted and correlated to the gene expression of differentially expressed genes in high/low glioblastoma survivorship. Not only were 23 novel genetic associations discovered, but a prediction model of glioblastoma survivorship utilizing the textural features was also constructed with high accuracy. GlioVision is high speed, low cost, and ready to implement with significantly improved accuracy over the current gold standard. The patent-pending GlioVision system pioneers the segmentation of tumor features and prediction of molecular subtype and gene methylation status from a WSI.

Awards Won:
Third Award of $1,000
Association for the Advancement of Artificial Intelligence: Honorable Mention