【CL2-3】

Applications of persistent homology to immunochemistry

Takashi Teramoto[1], Akihiro Takiyama[2]
[1]School of Medicine, Asahikawa Medical University
[2]Hokkaido Bunkyo University

Immunohistochemical data (IHC) plays an important role in clinical practice, and is typically gathered in a semi-quantitative fashion that relies on some degree of visual scoring. However, visual scoring by a pathologist is inherently subjective and manifests both intra-observer and inter-observer variability. In this study, we introduce a novel computer-aided quantification methodology for immunohistochemical scoring that uses the algebraic concept of persistent homology.

Using image data derived from 30 specimens of invasive ductal carcinoma of the breast, stained for the replicative marker Ki-67, we computed homology classes. These were then compared to nuclear grades and the Ki-67 labeling indices obtained by visual scoring. Combining this approach with biostatistical analysis, results in a diagram of homology classes classified into positive and negative groups. The new metrics for IHC staining were defined: the percentage of positive groups in all homology classes, called the Persistent Homology Index (PHI). Comparisons of PHI versus a pathologist-derived Ki-67 labeling index demonstrated a high Spearman correlation of 0.81 ($p < 0.001$), confirming that our novel approach yields highly similar data to that generated by visual evaluation, although PHI data are informed by a richer biologic dataset than conventional evaluation methods.