

## AI-empowered tumor diagnosis using PATH-zle, the first user-friendly AI tool for tissue reconstruction

V. Martin<sup>1</sup>, G. Abbate<sup>2</sup>, L. Giudici<sup>1</sup>, B. Forni<sup>3/4</sup>, P. Migliora<sup>1</sup>, A. Giusti<sup>2</sup>, L. Mazzucchelli<sup>1</sup>

1) Istituto di Diagnostica Integrata della Svizzera Italiana, Clinica di Patologia – EOC, Locarno

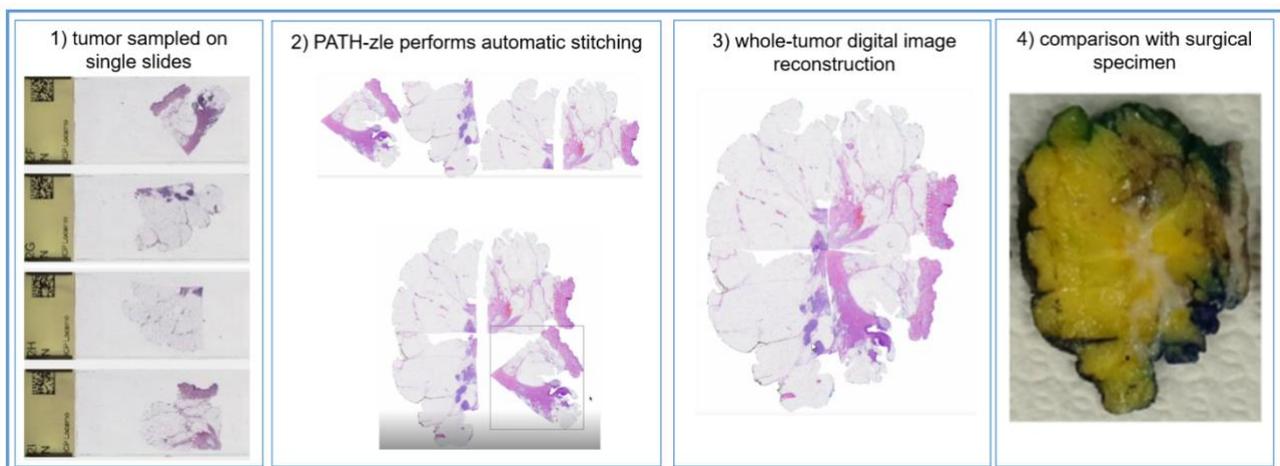
2) Istituto dalle Molle di Studi sull'Intelligenza Artificiale (IDSIA USI-SUPSI), Dipartimento di Tecnologie Innovative, SUPSI, Lugano

3) Università della Svizzera Italiana (USI), Lugano

4) Università di Pavia, Italia

**Background.** Accurate and precise histopathological diagnosis is essential for optimal therapeutic decision-making in oncology. With the rapid transition from optical microscopy to fully digital workflows, pathology is undergoing its game changer transformation. Digital pathology in fact enhances speed, accuracy, sharing, education, and, crucially, the integration of AI-driven tools that support the diagnostic process. Larger tumor specimens cannot be analyzed in their entirety; during the grossing phase they must be divided into smaller tissue portions that fit into standard paraffin blocks. Each portion then undergoes specific pre-analytical processes and is used to prepare individual histological slides. This approach results in a loss of the overall perspective of the sample.

**Methods.** We implemented PATH-zle, an AI-based, user-friendly tool designed to automatically reconstruct whole-tumor digital image by stitching together multiple tissue samples mounted on separate glass slides (e.g., breast, colon, lung, and prostate cancer samples). Leveraging high-resolution digital slide inputs, PATH-zle performs automatic stitching, orientation alignment, and structural reconstruction to generate a coherent and anatomically faithful representation of the entire tumor section or specimen (see figure below).



**Results.** By providing a single comprehensive digital reconstruction, PATH-zle eliminates the need for manual mental reconstruction traditionally performed by pathologists when reviewing slides individually. This significantly improves precision, speed, standardization, and reduces cognitive load. The single generated comprehensive digital reconstruction can be seamlessly shared, reviewed through standard digital pathology viewers, and analyzed using conventional measurement or quantification tools (e.g., tumor dimensions, depth of invasion, distance from the margins, area, cell counts). Furthermore, PATH-zle output is fully compatible with downstream AI-based analytical pipelines, facilitating multi-layered computational assessment.

**Conclusions.** PATH-zle enables, for the first time in histopathology, a full-field, spatially faithful view of the tumor and its sampled context, reflecting their original arrangement within the surgical specimen, something previously achievable only through radiological imaging modalities such as CT or MRI scans. By bridging the gap between radiologic and histologic visualization, this technology lays the foundation for future multimodal integration and image fusion. Its implementation has the potential to deeply reshape diagnostic workflows, elevate precision oncology, and accelerate the adoption of AI as a transformative force in modern pathology.