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Classification of degree of differentiation of colorectal neoplasm by the concept of the homology

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Introduction: Recently, a new method based on the homology theory for analyzing histological digital images has been developed. The method evaluates the Betti numbers in a unit area of an image of a colon to determine the region of interest (ROI). The Betti number can be used to assess the degree of connectivity in tissue. Here, we change the binarizing threshold and investigate the relation between the change ratio of the Betti numbers and the different types of cancerous tissue.

Materials & Method: Colonic specimens were provided by the Osaka Medical Center for Cancer and Cardiovascular Diseases. Data were gathered for internal quality control on a routine basis and all patients gave informed consent for data collection.

Results: The calculated results can be approximated by quadratic functions. The distribution of the coefficient on the squared term and the x-coordinates of the vertices are shown. We can see a characteristic distribution for each type of cancerous tissue.

Discussion: As the binarizing threshold decreases, the images gradually fade to white and the structure of the tissue is lost. Under the proposed procedure, in areas where the connections in the tissue are tight and clear, the one-dimensional Betti number changes slowly; conversely, where the connections are vague, such as in a background area filled with impurities, it changes very quickly. The state of this change can be considered an expression of the strength of the connectivity and it differs by type of cancerous tissue.

Biography

Kazuaki Nakane has obtained his PhD at Kanazawa University. He is a guest Associate Professor and a specially appointed Researcher in Osaka University. By using an idea of homology, he has developed a new image analysis method and applied this method to detect cancer lesion. He has also been successful in image analysis of complex images which seem to have mathematical structures.

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