Description of hepatic HCC lesions using persistent homology

Our research group focuses on the computer evaluation of tumoral response.

For hepatic diseases, in particular HCC (HepatoCellular Carcinoma) - 5th cause of cancer in the World (500,000 new cases / year) - 3rd cause of death by cancer in the World.

INTRODUCTION

APPLICATION TO MEDICAL IMAGE PROCESSING

A popular tool in topological data analysis.

Algebraic tool for discerning topological features (holes, graph) of data.

Shape analysis : holes representation using thickness, breadth [Aldo et al., 2016].

Shape analysis : topological invariant [Anne Collins et al., 2004].

METHOD : PERSISTENT HOMOLOGY (PH)

Image I

the distance from the lesion border to each pixel

pixel intensity (ranked in ascending order)

Barcode

metric \( \delta(I, J) = |U - \cap | \)

\( l = \begin{bmatrix}
0.1 & 0.12 & 0.13 & 0.14 & 0.15 \\
0.16 & 11 & 12 & 13 & 14 \\
0.18 & 14 & 15 & 16 & 17 \\
0.2 & 17 & 18 & 19 & 20 \\
0.22 & 23 & 24 & 25 & 26
\end{bmatrix} \)

\( BW = \begin{bmatrix}
0 & 0 & 0 & 0 & 0 \\
1 & 1 & 1 & 1 & 0 \\
1 & 1 & 1 & 1 & 0 \\
0 & 1 & 1 & 1 & 0 \\
0 & 0 & 0 & 0 & 0
\end{bmatrix} \)

RESULTS

Database : 10 000 patches of healthy tissue / 100 patches of lesion.

Persistence for lesion

Persistence for healthy tissue

CONCLUSION

This framework may be complementary to the standard techniques currently in use.

Extract topological features to compute the persistence can improve the result.

Useful for segmentation of tumor.

This framework is flexible enough to be used in a variety of contexts.

BIBLIOGRAPHY

