Cancer Risk Assessment Related to Anatomical Tissue Types

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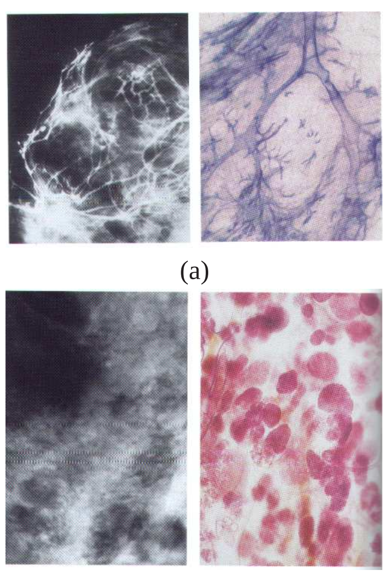
With increasing demands on screening programs it might become essential that automatic cancer risk assessment methodologies are developed and clinically implemented. There are currently cancer risk assessment models that take personal information (e.g. family and environment) into account, but the tendency is that the available image information is not fully integrated in this process. However, the correlation between the morphology and appearance of anatomical tissue types and risk has been established. Limited automatic cancer risk estimation approaches have been developed based on simple histogram image information, but although this provides acceptable correlation with risk; this does not provide additional understanding between tissue types and their relation to cancer risk. It seems essential that automatic methods are developed which will enhance the understanding of image based cancer risk assessment. For full understanding, it is expected that such methods will need to establish the correlation between radiological image information and histological data (see Fig. 1 for mammographic examples). Clearly, registration covering different resolutions for such images will be needed, which in the first instance will need studies that cover histological information from the full anatomical structure under investigation. Once understanding of the registration of full anatomical structures is understood, local aspects can be investigated. In the mammographic case (but this will be widely applicable to other application areas), there are a few fundamental tissue building blocks (nodular densities, linear structures, homogeneous densities and radiolucent areas [1]). It is our belief that segmentation methods will need to be established that determine the probability of such tissues types within the images, and might have to do so at both radiological and histological image resolutions. These segmentation methods will be expected to rely on a mix of existing statistical methods in combination with novel topological data analysis and visualisation techniques. E.g. Fig. 2 visualises simple diemsionality reduction results from high dimensional data, where the different colours represent different image structures (tissue types) and location on the individual strands provides information on the morphology/contrast of the image structure. Such visualisation techniques need to be fully integrated within segmentation methods. However, significant work will be needed to link the representation of the data to the tissue types.



(a)

(b)

Figure 1. Mammographic linear (a) and nodular (b) example images [1], covering radiological (left) and histological (right) information.

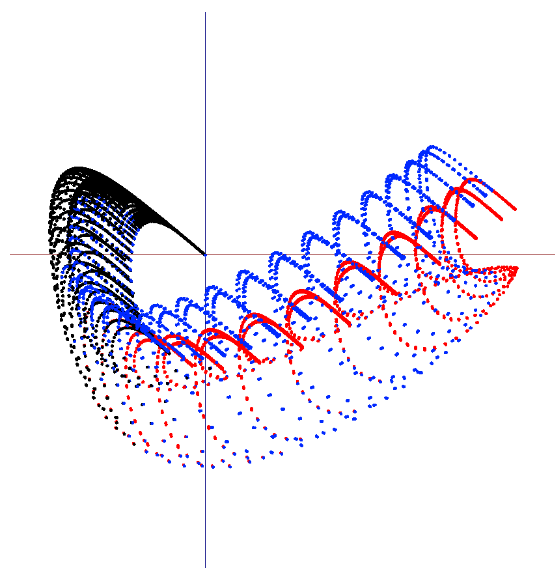


Figure 2. Visualisation (two PCA related components) of high dimensional data, where it is expected that the various strands/colours are related to tissue types.

References

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