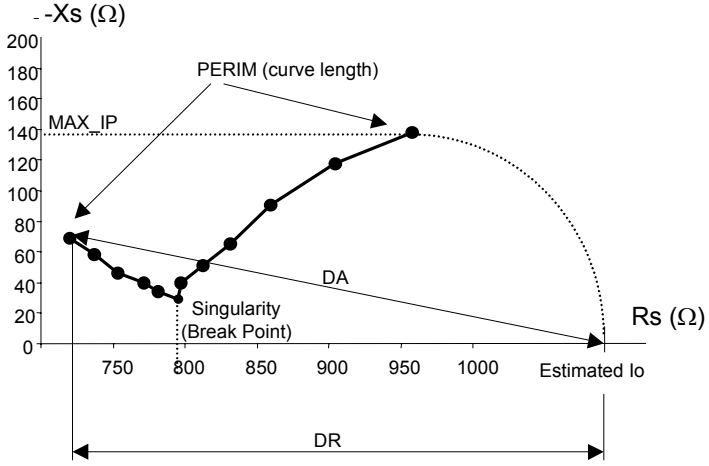
Classification of breast tissue by electrical impedance spectroscopy

Objective:

To develop a classification methodology capable of accurately discriminate several types of freshly excised breast tissue, using electrical impedance measurements. This project followed the main lines suggested in a previous study developed by INSERM U.281, Lyon.

Methods and Results:

Several features were derived from the Argand plane representation of electrical impedance measurements of several tissue types. The electrical impedance data (106 cases) was collected and made available by INSERM U.281, Lyon (see figure). Six tissue classes were represented in the data: adipose, connective, glandular, fibro-adenoma, mastopathy, carcinoma.



From the statistical analysis we concluded that a sensible approach to the classification process was to perform it in two hierarchical stages using discriminant analysis as follows: a) First, rule out connective and adipose tissue cases from all the others. The Io characteristic is sufficient to perform this separation with 100% efficiency (100% correct classification); b) Second, if it is not a connective or adipose tissue case, a test is made to discriminate carcinoma from glandular + fibroadenoma + mastophaty tissues using the AREA/DA and MAX_IP features. This can be made an overall error of 8%. Adjustment of the linear discriminating boundary will improve the false negative rate to nearly 0% with only a minor increase of the false positive rate. The estimated error figures are believed to be quite accurate given the very low number of used features (only 1 for the first stage and 2 for the second stage) compared with the lowest number of available cases per class used in the analysis (21 for the carcinoma class).

Taking into account the good results concerning carcinoma discrimination as well as the low cost and ease of use of the electrical impedance technique, we conclude that this method seems to be an interesting candidate for screening application in breast cancer detection.

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