

Title: Cosmetic Evaluation of Breast Interventions

Motivation:

Breast cancer is the most common cancer to affect women in Europe and as 10-year survival from the disease now exceeds 80%, many women are expected to live a long time with the aesthetic consequences of their treatment. The importance of good aesthetic outcome is well recognised by experts in this field although it is known that this is often not achieved. In breast-conserving surgery for example, approximately 30% of women will have a suboptimal or poor aesthetic outcome.

A significant obstacle in auditing this problem and evaluating techniques for improving it has been the absence of a standard method for measuring aesthetic outcome. Most commonly used methods involve subjective assessment by an expert panel. Objective methods are also employed but usually assess just one aspect of cosmesis such as nipple symmetry. All methods so far described are subject to significant intra-observer and inter-observer variability. There is a need to replace or enhance human expert evaluation of the aesthetic results of breast surgery with a validated objective tool. This needs to be easy to employ, completely reproducible and acceptable to those who would be evaluated.

The proposed PhD project aims at overcoming the acute shortage of such software systems and exploit the unique ability (rarely exploited so far in the context of breast intervention assessment) of computational methods to provide an effective and easy to use tool for breast cancer patient care. A good aesthetic outcome is an important endpoint of breast cancer treatment. It is closely related to psychosocial recovery and quality of life. We aim at developing a totally automatic system capable of objectively evaluating the overall aesthetic result of local breast cancer treatments.

The proposed system should also be able to evaluate the effect on breast appearance of other treatments such as breast radiotherapy. In an era where many new methods of delivering radiotherapy are being proposed and evaluated, a method of analysing the aesthetic impact of such therapies would have obvious utility.

Additional benefits of the proposed development of computational methodology in this project are envisaged. For instance, there is also a need for a tool to simulate surgical options and outcomes for patients in terms of volume gain or loss and to better educate patients, such that they can make better decisions when electing or being recommended breast surgery. A more accurate, objective tool to predict surgical outcome and guide the patient and surgeon in the decision making and planning process is feasible with 3D imaging and surgical simulation. This may help predict an “ideal implant” in augmentation or reconstruction for the patient based on the patient’s body characteristics and habitus, resulting in a more natural appearance of the breast. A simulation model will also allow a patient to view themselves with the outcome of different surgical options.

Not only this project will create a computer platform to demonstrate that a computer-aided medical system can now be devised capable of meeting all of the above criteria, the process of designing and specifying this system will also enable the project partners to identify and address any outstanding issues.

Objectives:

In line with the aforementioned, the following constitute the objectives of the PhD project:

- To recognise the main factors contributing to the overall aesthetic result of breast cancer treatments.
- To develop image analysis methods and define metrics on the digital image, capturing the factors identified as contributing to the overall aesthetic result of breast cancer treatments.
- To develop methods of artificial intelligence, namely from the predictive learning theory, specifically adapted to the problem of predicting ordinal classes, constituting the possible classes of assessment.
- To develop an automatic and totally objective system for the assessment of the aesthetic result of surgery and radiotherapy to the conserved or reconstructed breast.
- To demonstrate that the resultant assessment from the system is accurate, reproducible, objective and mimics the human assessments.
- To compare the system with present methods described to evaluate the cosmetic results of surgery and radiotherapy to the intact breast or restored breast: subjective by panel evaluation, objective measurements, self-evaluation questionnaire.

Proponents:

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