DETERMINING METRICS FOR RECONSTRUCTION OF CORNEA USING IMAGE PROCESSING AND NEURAL NETWORK MODELLING

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Introduction

- To predict the thickness of cornea of a patient who will undergo corneal reconstructive surgery by

  a) Measuring the thickness of a cornea in the pre-surgery & post-surgery stage and those of the donor from images of cornea obtained using OCT using image processing techniques and use the results

  b) To Predict the thickness of cornea of a reconstructed eye using neural network modelling implemented in MATLAB environment.

Methods

A) To measure the thickness of cornea

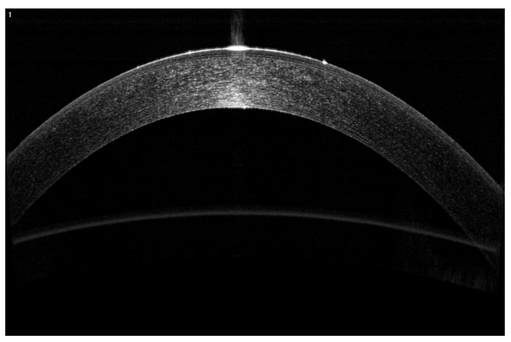

Fig-1.Sample Image of a Cornea obtained using OCT

Image Processing Algorithm involved

a) Converting into binary image

b) Remove Noises using filters

c) Detect edges using Sobel filter

d) Filling gaps and dilation

e) Polynomial Fitting

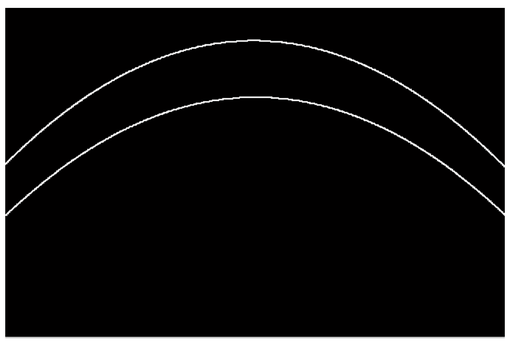

Fig-2.Image obtained after the application of algorithm

B) Neural Network modelling for predicting the thickness of cornea

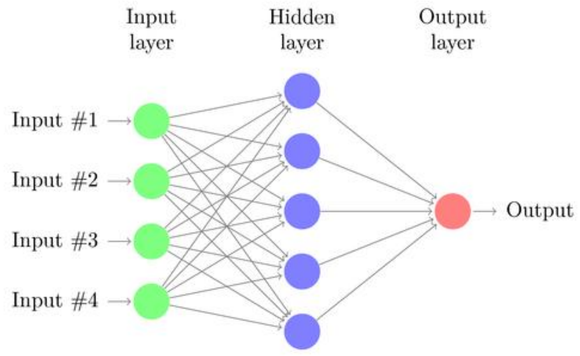

Fig-3. Simple Model for a Neural Network

Neural Network Model involves
a) Input Neurons – Thickness of cornea of pre-surgery (damaged eye).
Output Neurons – Thickness of cornea of post surgery eye.

b) No. of neurons in the hidden layer (1-10)

c) Training the network using Levenberg-Marquardt back-propagation algorithm

d) Deploy the solution to predict the thickness of cornea post-surgery given the pre-surgery.

Results

Patient No.	Actual thickness Post Surgery (µm)	Predicted Thickness Post Surgery (µm)	Percentage Change (%)
1	461.22	477.27	+3.48
2	487.99	531.68	+8.95
3	494.16	528.79	+7.01
4	547.70	527.35	-3.71
5	560.05	490.81	-12.34
6	485.93	521.52	+7.32
7	490.05	512.30	+4.54
8	537.40	521.52	-2.95
9	535.40	520.02	-2.87
10	520.93	528.37	+1.43

Prediction Error (%) = **+1.09** (Increase from the Actual Thickness)

Conclusions

This poster discusses the development of an image processing algorithm whose results where used in a neural network model to predict the thickness of cornea post-surgery from the thickness of cornea obtained in the pre-surgery stage.

Since the neural network is a learning based approach for function approximation, more instances of training data will improve the ability of the model to predict results accurately.

Literature Cited

- Digital Image Processing Using MATLAB, 2e, Gonzalez and Woods
- Kenneth Levenberg (1944). “A Method for the Solution of Certain Non-Linear Problems in Least Squares”. *Quarterly of Applied Mathematics* **2**: 164–168.
- Donald Marquardt (1963). “An Algorithm for Least-Square Estimation of Non-linear parameters”. *SIAM Journal on Applied Mathematics* **11** (2): 431–441.

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