ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Analysis of Ulcer Wound Using Fuzzy Logic

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Abstracts

Patient wound image analysis finds its application in healthcare to monitor the extent of wound healing and to decide the course of treatment. To demonstrate the effects of a new drug, in wound healing techniques, the wound surface area is one of the most important variables. This paper involves the use of knowledge-base (fuzzy expert) systems that are capable of following the behaviour of a human expert. Fuzzy logic has rapidly become one of the most successful of today's technologies for developing sophisticated control systems. The reason for which is very simple. Fuzzy logic addresses such applications perfectly as it resembles human decision making with an ability to generate precise solutions from certain or approximate information.

Keywords: fuzzy logic , digital image processing , ulcer wound, telemedicine.

Introduction

Chronic wounds of the lower extremity also have important negative effects on the individual's quality of life due to pain,immobility, offensive smell, social stigma and social isolation . Consequently there remains a need to develop precise measurement, documentation and research systems that can be easily used by clinicians to monitor the effectiveness of existing slides[3]. However, the need for colour images has been stressed[8] because chronic wounds can have a mix of yellow slough, red granulation and black necrotic tissue and the proportions of each are important determinants of wound healing[2]. Wound assessment not only guides treatment, it is necessary to monitor the progress and effectiveness of treatment[17]. It has been suggested that wound measurement is one of the great mysteries of wound management and that there is no one way of measuring a wound that is accurate, consistent, cheap and easily used[2]. Fuzzy logic has rapidly become one of the most successful of today's technologies for developing sophisticated control systems. The reason for which is very simple. Fuzzy logic addresses such applications perfectly as it resembles human decision making with an ability to generate precise solutions from certain or approximate information. Telemedicine is the use of telecommunication and information technologies in order to provide clinical health care at a distance. It helps eliminate distance barriers and can improve access to medical services that would often not be consistently available in distant rural communities. It is also used to save lives in critical care and situations. Although there were distant precursors to telemedicine, it is essentially a product of 20th century telecommunication and information technologies. These technologies permit communications between patient and medical staff with both convenience and fidelity, as well as the transmission of medical, imaging and health informatics data from one site to another [18]. Ulcers are chronic wounds that do not heal within a predictable amount of time causing severe pain and discomfort to the patients. Ulcers are most commonly found on the lower extremity below the knee and affect around 1% of adult population and 3.6% of people older than 65 years [5]. Chronic ulcers introduce not only a major problem in dermatology but an economic dilemma especially in western countries. In the United States alone , chronic wounds affect 3 million to 6 million patients and treating these wounds costs an estimated $5 billion to $10 billion each year [3].In clinical practice, doctors normally describe the tissues in-side the ulcer in terms of percentages of each tissue colour based on visual inspection[5] 6,7. The ultimate goal of this research is to produce objective non-invasive technique that aid doctors in dermatology clinics assess the healing status of chronic ulcers in a more precise and reliable way[8].

We propose to carry our work on following lines.

1. We will take pictures of wound at regular interval.
2. We will enhance the true wounded region based on fuzzy logic. .For this we will use fuzzy logic toolbox.
3. RGB Values of image will be passed to fuzzy logic toolbox.
4. Rules will be framed in Fuzzy Sense to differentiate between different levels and shades of colors in human sense. ("DARK,

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RED,LIGHT RED,DARK GREEN ,LIGHT GREEN ,DARK BLUE ,LIGHT BLUE)

5. Fuzzy output will differentiate between ambiguous colors.
6. Decision making algorithm will be written which will enhance only wounded region
7. Thus every pixel on image will be discriminated using fuzzy rules and hence output picture will enhance only special features of image.

on image will be discriminated using fuzzy rules and hence output picture will enhance only special features of image.

Fuzzy inference system

Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned. The process of fuzzy inference involves all of the pieces that are described in the previous sections: Membership Functions, Logical Operations, and If-Then Rules. You can implement two types of fuzzy inference systems in the toolbox: Mamdani-type and Sugeno-type. These two types of inference systems vary somewhat in the way outputs are determined.process of fuzzy inference involves all of the pieces that are described in the previous sections: Membership Functions, Logical Operations, and If-Then Rules. You can implement two types of fuzzy inference systems in the toolbox: Mamdani-type and Sugeno-type. These two types of inference systems vary somewhat in the way outputs are determined. Mamdani's fuzzy inference method is the most commonly seen fuzzy methodology. Mamdani-type inference, as defined for the toolbox, expects the output membership functions to be fuzzy sets. After the aggregation process, there is a fuzzy set for each output variable that needs defuzzification.

You can use five primary GUI tools for building, editing, and observing fuzzy inference systems in the toolbox:

Fig: Fuzzy interface system

- Fuzzy Inference System (FIS) Editor
- Membership Function Editor
- Rule Editor
- Rule Viewer
- Surface Viewer

Fuzzy inference system (FIS) editor

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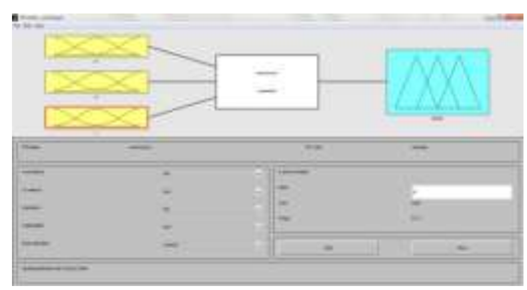

Membership function editor

Constructing rules using the graphical Rule Editor interface is fairly self-evident. Based on the descriptions of the input and output variables defined with the FIS Editor, the Rule Editor allows you to construct the rule statements automatically, by clicking on and selecting one item in each input variable box, one item in each output box, and one connection item. Choosing **none** as one of the variable qualities will exclude that variable from a given rule. Choosing **not** under any variable name will negate the associated quality. Rules may be changed,

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deleted, or added, by clicking on the appropriate button. The Rule Editor also has some familiar landmarks, similar to those in the FIS Editor and the Membership Function Editor, including the menu bar and the status line. The **Format** pop-up menu is available from the **Options** pull- down menu from the top menu bar — this is used to set the format for the display.

Fig: Membership function editor

The rule viewer

The Rule Viewer displays a roadmap of the whole fuzzy inference process. It's based on the fuzzy inference diagram described in the previous section. You see a single figure window with 10 small plots nested in it. The three small plots across the top of the figure represent the antecedent and consequent of the first rule. Each rule is a row of plots, and each column is a variable. The first two columns of plots (the six yellow plots) show the membership functions referenced by the antecedent, or the if-part of each rule. The third column of plots (the three blue plots) shows the membership functions referenced by the consequent, or the then-part of each rule.

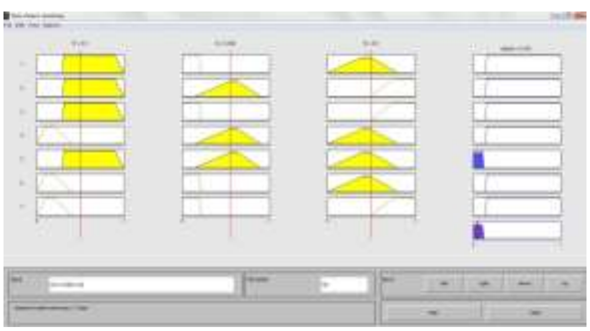

Fig: The rule viewer

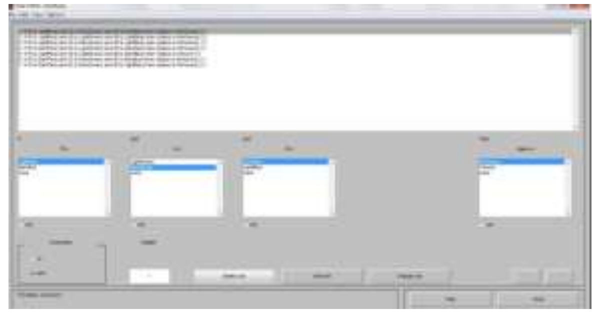

Fig: The rule editor

The surface viewer

Upon opening the Surface Viewer, we are presented with a two-dimensional curve that represents the mapping from service quality to tip amount. Since this is a one-input one- output case, we can see the entire mapping in one plot. Two-input one-output systems also work well, as they generate three-dimensional plots that MATLAB can adeptly manage. When we move beyond three dimensions overall, we start to encounter trouble displaying the results. Accordingly, the Surface Viewer is equipped with pop-up menus that let you select any two inputs and any one output for plotting. Justbelow the pop-up menus are two text input fields that let you determine how many *x-axis* and *y-axis* grid lines you want to include. This allows you to keep the calculation time reasonable for complex problems. To change the *x-axis* or *y-axis* grid after the surface is in view, simply change the appropriate text field, and click on either **X-grids** or **Y-grids**, according to which text field you changed, to redraw the plot.

Input and output

On execution of our algorithm we obtained the result as given below. The snapshots are given as follows:

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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Fig: Original image, eroded image and fuzzy segmented wound

Conclusion

An optimal set of techniques for analysis of healing or non healing wound, have been discussed in this journal. Here we have used the knowledge-base (fuzzy expert) systems that are capable of mimicking the behavior of a human expert. Fuzzy logic addresses such applications perfectly as it resembles human decision making with an ability to generate precise solutions from certain or approximate information. . Future scope of this research can be extended to multi-view tissue classification and 3D modelling .

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