GUI FOR VOIDS SEGMENTATION

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This paper presents GUI created in software Matlab. Matlab was chosen because it has very usefull and powerfull library of functions in Image Processing Toolbox. GUI can be use for searching and segmentation of voids in images of real composite structure. Woven composites are prepared by the use of prepreg technology under joint pressing and heat-treatment. The hot pressing evokes the change of a reinforcement geometry and material structure. Voids and other imperfections are formated in internal structure. Imperfections influence mechanical and thermal composite properties. On that ground, it is necessary to know voids geometry. Woven composite are reinforced with woven fabrics in resin. Woven fabric is one component and resin are second component. Woven fabrics are created from two systems of parallel yarns, which are crossed at right angles. The interlaced yarns are periodically crimped (undulated) in three type of weave – plain, satin, twill.

Images of structure have been obtained from destructive testing - cross-section surface - and episcopic microscanning with color CCD camera DM1. See Fig. 1.
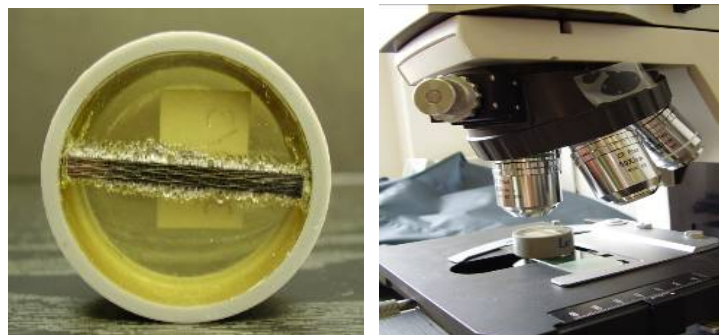

Fig. 1 Cross-section surface and microscanning

Episcopic scanning have to be take over internal norm of Laboratory for image analysi of Research Centre Textil II at Technical University of Liberec. Microscanning is very complicated step, it is difficult to differ individual composite components, because material components have similar chemist constitution. For more details about microscanning see [2]. Three type of woven composites - glass fiber/polysiloxane resin, glass fiber/epoxyd resin, carbon fiber/carbon resin - can be scann by this internal norm. Using internal norm supports the best input image into GUI.

First step of segmentation is image conversion from RGB to grayscale. It was used function RGB2GRAY. Still, binary format is necessary. For converting to binary image by tresholding it was use function IM2BW or its advanced version GRAYTRESH. GRAYTRESH efectively computes global treshold by Otsu's method. Treshold value setting can be the manually or automatically.

Next step is very important, consideration is about the scale significant for phenomenon interesting for us. Therefore the size of voids (in pixels) is analyzed, these voids appears as a conected areas with the certain amount of pixels. Now there is aproximately known limits of size only of „interesting" voids, then follows the selection of interesting area by function BWAREAOPEN and erasing almost all of uninteresting conected areas. Voids and some of conected areas are the rest. Program is equiped by possibility, that operator can decide and erase arbitrary areas.

Hereinafter part of program for selection and erasing of uninteresting and interesting area is showed.

```
% %%%%%%%%%%%%%%%%%%%%%%%%%
function pushbutton12_Callback(hObject, eventdata, handles)
hod_mensi = str2num(get(handles.edit1,'string'));
obrazek = handles.obrazek;
rozmer = size(obrazek);

    obrazek = bwareaopen(obrazek,hod_mensi);
    inv_bi_img = imcomplement(obrazek);
    bwAreaOpen = imcomplement(bwareaopen(inv_bi_img,hod_mensi));

    hold off
        axes(handles.axe
vyrez = bwAreaOpen(1:rozmer(1,1), 1:1200);
    imshow(vyrez);
   hold on
handles.obrazek = bwAreaOpen
guidata(hObject, handles);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
function pushbutton13_Callback(hObject, eventdata, handles)
obr = handles.obrazek;
obr_odsr_velky = bwareaopen(~obr,80000);
rozmer = size(obr);
for i = 1 : rozmer(1,1)
   for j = 1 : rozmer(1,2)
      if (obr(i,j) == obr_odsr_velky(i,j))
         rozdil(i,j) = 0;
      else
         rozdil(i,j) = 1;
      end
   end
end
```

Afterwards the image is eroded with the appropriately structural element and subsequently dilatated with the same structural element. This eliminates frazzle of borders of voids. Now only outlines of voids are needed. It is very easy to get outline of object of binary image. Erode image by square 3 x 3 structural element and subtraction from original image are the last steps.

Fig.2 illustrates user's using of GUI.

Push button for reading image
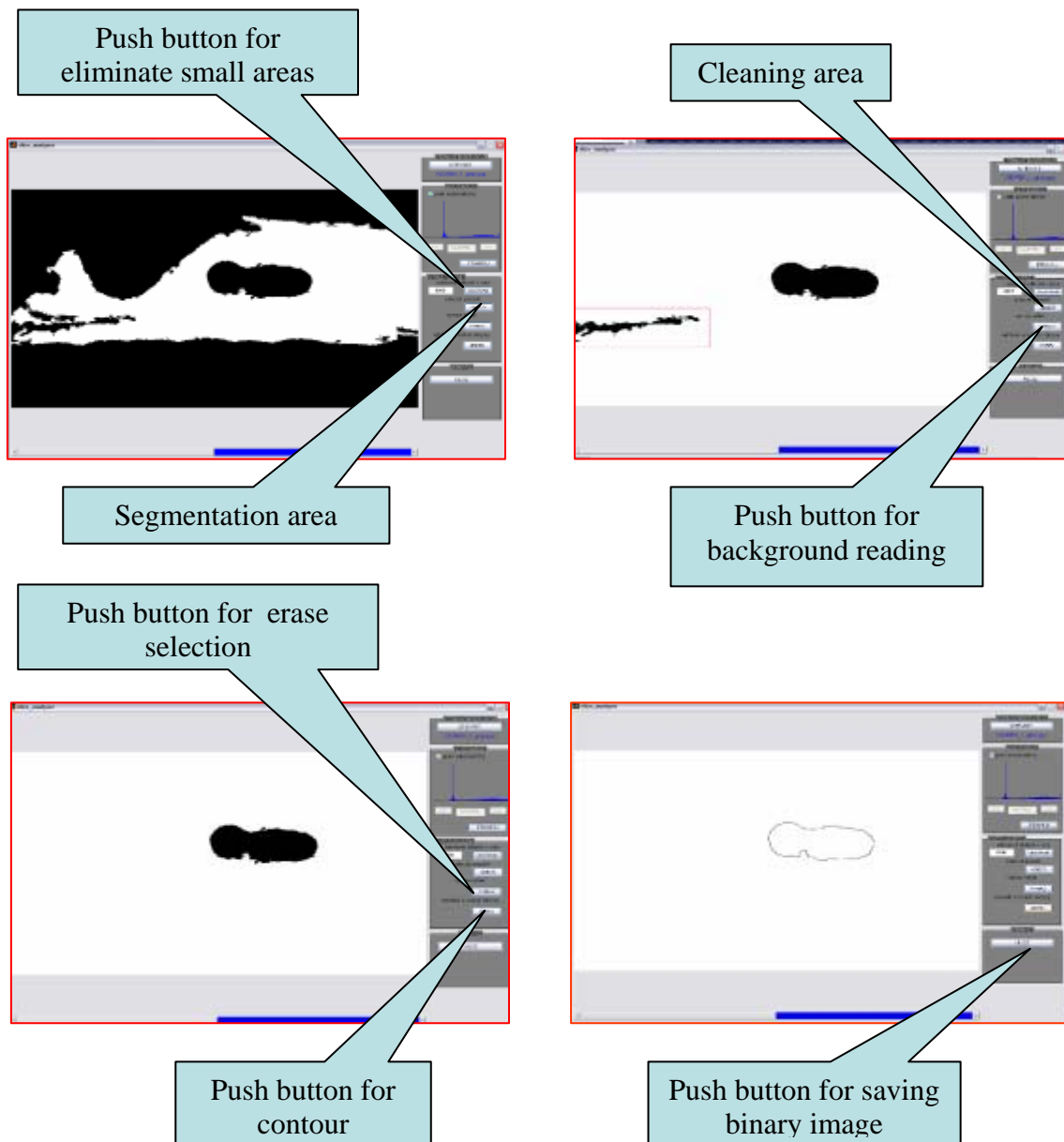
Thresholding area

Scroll bar
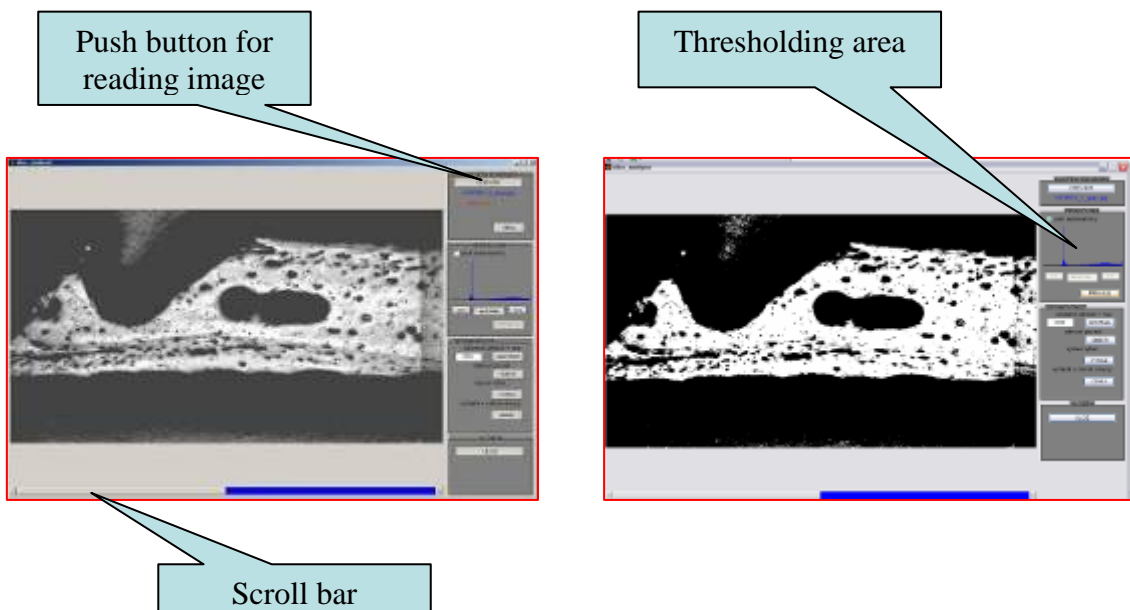
Fig. 2 User's manipulation of GUI

Contour of voids are important step for good description of real geometry. In this time similar GUIs are prepared for contour selection of others structural components – longitudinal and cross fibers.

Good description is necessary step of building FEM-model for physical properties prediction. All of this knowledge can be used for evaluation of the effect of pressmold and weave-pattern on physical properties, for more specification of mezo- and micromechanical models and for proposing of optimisation algorithm.

References

[1] *Matlab reference manual*, http://www.humusoft.com

[2] Salacova J., Ledl V., Jancik P.: *CONTOUR SELECTION FOR VOIDS OF REAL WOVEN COMPOSITE STRUCTURE*, ICCE 14, New Orleans, Colorado, USA, 2006

[3] Salacova, J.:*Cooperation of software Lucia^{tm} G,Matlab^{®},Femlab into woven composite,* Matlab 2004,Praha CR,2004

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