

## Nové možnosti rozvoje vzdělávání na Technické univerzitě v Liberci

Specifický cíl A2: Rozvoj v oblasti distanční výuky, online výuky a blended  
learning

NPO\_TUL\_MSMT-16598/2022



## One-component, two-component yarns - internal structure

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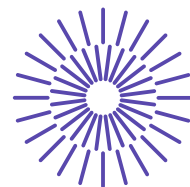
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MLÁDEŽE A TĚLOVÝCHOVY



## Single component yarns (ring, rotor) - internal structure (direct method, Secant method)

### Task:

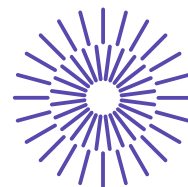
1. Familiarize yourself with the image analysis program NIS Elements.
2. Prepare a cross-section with the submitted yarn according to IN 46-108-01/01.
3. Determine the packing density of the yarn by the **direct method** using the prepared macro "ZaplneniZKontur.mac" on your yarn cross-section.
4. Determine the effective yarn diameter  $D_{ef}$  and using the values of the average coordinates of the fiber centers in the cross-section (see the output file "StredyVlaken.txt"), find the effective packing density  $\square_{ef}$  on the binary image of the yarn cross-section.
5. Calculate the fineness of your yarn knowing the density of the fibers (material?)...
6. Find out the packing density of the yarn by the Secant method from the data contained in the output table (Results of automatic measurement "Center X", "Center Y") and the parameter of the given cross-section, see Table 1.
7. Process the data together with the input parameters in the program "Prize.exe". You will be interested in the radial packing density, the effective diameter  $D_{ef}$  and the effective packing density  $\square_{ef}$ .
8. **Compare the respective results for one cross-section within the direct method and the Secant method and within the two yarn types.**

### Tools:

- NIS Elements image analyzer

### Source of information:

- EXA - KTT lectures



- Internal standard IN 46-108-01/01 Recommended procedure for the creation of cross-sections. Soft and hard cuts
- Internal Standard IN 22-103-01/01: Yarn packing density. Direct method and Secant method
- Internal Standard IN 22-103-02/01: Yarn packing density - Direct method

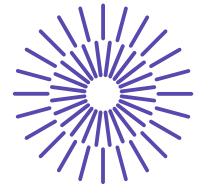
<i>Table 1: Yarn and fibre parameters</i>				
Fiber fineness [tex]	Fibre density [kg.m <sup>-3</sup> ]	Fineness of yarn [tex]	The yarn twist [m <sup>-1</sup> ]	Width of the annulus [mm]
0,16	?	?	?	0,01

### The principle and procedure of working with image analysis:

In general, image analysis is based on capturing and converting an image into digital form, transforming the image (image editing), identifying (image segmentation) objects or textures (fields), and finally quantifying it into a limited number of data and measurements.

The colour image of the yarn cut prepared by you will be used for this task. For its processing, the pre-prepared macro "ZaplneniZKontur.mac", whose body with description is attached to this task, will be helpful.

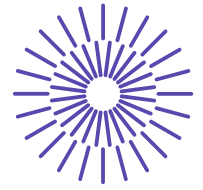
- Macro - Open ... "ZaplneniZKontur.mac"
- The contents of the macro can be checked by editing it - with the F8 key.
- Run the macro with the F4 key or directly in the macro editor or under Macro - Run
- Follow the instructions that appear in the top bar (select ONE COMPONENT YARN)...
- Once you have subjectively marked the boundaries of all the threads you then fill, the macro will begin to add ROIs to the section.



- F. The results can be found in: View - Analysis Controls - Automatic Measurement Results (Measurement of "Center X", "Center Y" objects (Export to Excel - these are the fiber centers), Measurement of "Part of Binary Area" fields (Export to Excel - this is the packing density in each annulus)).
- G. The average values of the measured coordinates of the fiber centers, i.e. basically the yarn center will also be the center of the circle with radius  $D_{ef}/2$  - see points 1, 2 below, which you create using the ROI tool in the right panel bar of the binary image of your cut.
- H. Now use the Measurement - Take Measurement item to measure the packing density in the circle you have drawn. The feature "Binary Area Fraction" is then  $\square_{ef}$ .

### Processing of measured data:

1. Use the data from the Field Measurements - specifically the flag "Binary Area Fraction" together with the width of the annulus to create a plot of the radial packing density, i.e. the packing density dependence  $\square = f(\text{radius})$ .
2. In Excel, create a radial packing density graph, use it to determine the effective yarn diameter  $D_{ef}$  and, using the average values of the coordinates of the fiber centers in the section (see Excel "Center X", "Center Y"), draw a circular ROI of diameter  $D_{ef}$  centered at the average values of the fiber centers on the binary image of the yarn section. Note that if you are working with a calibrated image, the coordinates of the centers are also in  $\square\text{m}$ .
3. From the knowledge of the yarn fiber density and the substantive area of the cross-section, see the sum of all binary areas of the "Binary Area" measurement fields, calculate the yarn fineness  $T$ .
4. The output of the problem will be: a graph of the radial packing density of your cross section, the effective yarn diameter  $D_{ef}$  [mm] and the effective packing density  $\square_{ef}$  [-], the yarn fineness  $T$  [tex].
5. Secant method: convert the coordinates of the centres (Excel - Fibre Centres - convert to \*.txt (data format: two columns, column names: CentreX, CentreY, decimal separator - dot) and use the parameters in Table 1 for evaluation in "Prize.exe". The output of this program is a \*.csv file which you open in Excel. From the data, create a



graph of the radial packing density of your yarn cross-section, find the value of the effective diameter  $D_{ef}$  [mm] and the effective packing density  $\mu_{ef}$  [-] in the data.

- Place the radial packing density of your cross-section from the two methodologies and for the two yarn types in one graph. Arrange the other output data in Table 2:

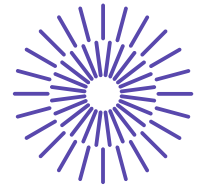
Table 2: Comparison of cross-section parameters from two methodologies for two yarn types

	$T$ [tex]	$D_{ef}$ [mm]	$\mu_{ef}$ [-]
Direct method - ring-spun yarn			
Secant method – ring-spun yarn	<i>Value from Tab. 1</i>		
Direct method - rotor-spun yarn			
Secant method – rotor-spun yarn	<i>Value from Tab. 1</i>		

## Two-component yarn - internal structure (Secant method), blend quality

### Assignment:

- Familiarize yourself with the image analysis program NIS Elements.
- Prepare a cross-section with the submitted blended yarn according to IN 46-108-01/01.
- Determine the yarn packing density by the **Secant method** from the data measured in the image analysis ("Centre X", "Centre Y") and the parameter of the submitted section, see Table 3.
- Process the data together with the input parameters in the program "Prize.exe". You will be interested in the radial packing density, the effective diameter  $D_{ef}$  and the packing density  $\mu_{ef}$ .



**5. Compare the packing density curves of the two components of the yarn.**

**Tools:**

- NIS Elements image analyzer

**Source of information:**

- EXA - KTT lectures
- Internal standard IN 46-108-01/01 Recommended procedure for creating cross-sections. Soft and hard cross sections
- Internal Standard IN 22-103-01/01: Yarn packing density. Direct method and Secant method

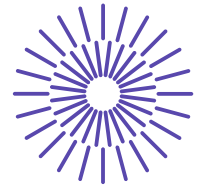
*Table 3: Yarn and fibre parameters*

Fiber fineness of the 1 <sup>st</sup> component [tex]	Fiber fineness of the 2 <sup>nd</sup> component [tex]	Fiber density of the 1 <sup>st</sup> component [kg.m <sup>-3</sup> ]	Fiber fineness of the 2 <sup>nd</sup> component [kg.m <sup>-3</sup> ]	Yarn count [tex]	Yarn twist [m <sup>-1</sup> ]	Annulus width [mm]
0,16	?	?	?	?	?	0,01

**The principle and procedure of working with image analysis:**

In general, image analysis is based on capturing and converting an image into digital form, transforming the image (image editing), identifying (image segmentation) objects or textures (fields), and finally quantifying it into a limited number of data and measurements.

In this task, you will subjectively mark the fiber centers of one component and, when they are saved, the fiber centers of the other component.



- A. Activate the Binary Image Editor (TAB key).
- B. Mark the fiber centers of the first component.
- C. In Measurement - Object measurement features..., select "Center X", "Center Y".
- D. Measure: Measurement - Take Measurement.
- E. Export the results to e.g. ba.txt file (two columns of measured data (decimal separator dot) and header "CentreX" "CentreY")
- F. Do not delete previous data. Follow the same procedure for the second component. Save the data of the centres of the fibres of both components in a file named bapop.txt.
- G. Save the image with the binary layer, e.g. in \*.jp2 format.

#### Processing of measured data:

1. Secant method: use the coordinates of the centres from the files ba.txt, bapop.txt and the parameters in Table 3 for evaluation in the program "Prize.exe". The output of this program is a \*.csv file that you open in Excel. From the data, create a graph of the radial packing density of your yarn cross-section, find the value of the effective diameter  $D_{ef}$  [mm] and the effective packing density  $\rho_{ef}$  [-] in the data.
2. Evaluate verbally the radial packing density of the two components in the two-component yarn.
3. Evaluate the quality of the mixing of the components directly in the image (see G above) by attaching e.g. an eyepiece scale (right bar in the image analysis).
4. Count the number of fibres of the component in a given annulus, then omit the numbers (preferably relative) depending on the radius of the annulus.
5. Add the IBI value (see lecture 09\_10EXA.ppt).
6. Save the image and the eyepiece scale, and insert the image and graphical conclusions into the report.

