Nové možnosti rozvoje vzdělávání na Technické univerzitě v Liberci

Specifický cíl A2: Rozvoj v oblasti distanční výuky, online výuky a blended learning
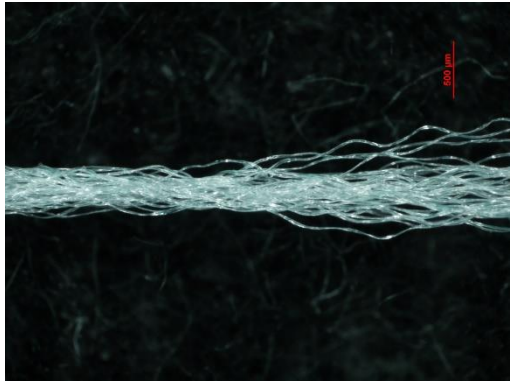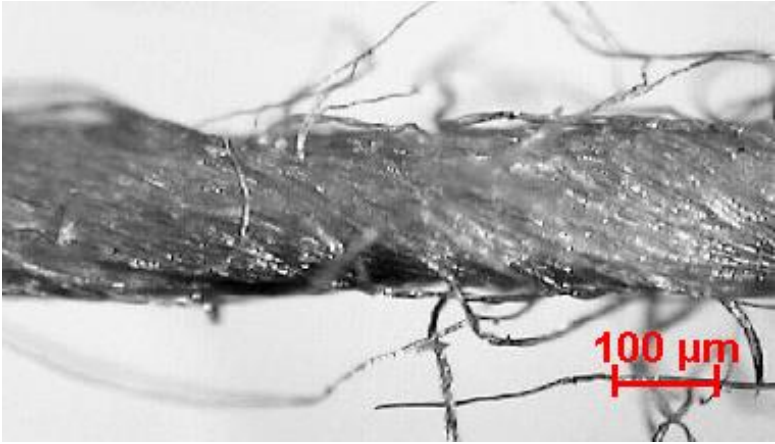
NPO_TUL_MSMT-16598/2022

Staple yarn and multifilament - surface structure and geometric parameters by image analysis
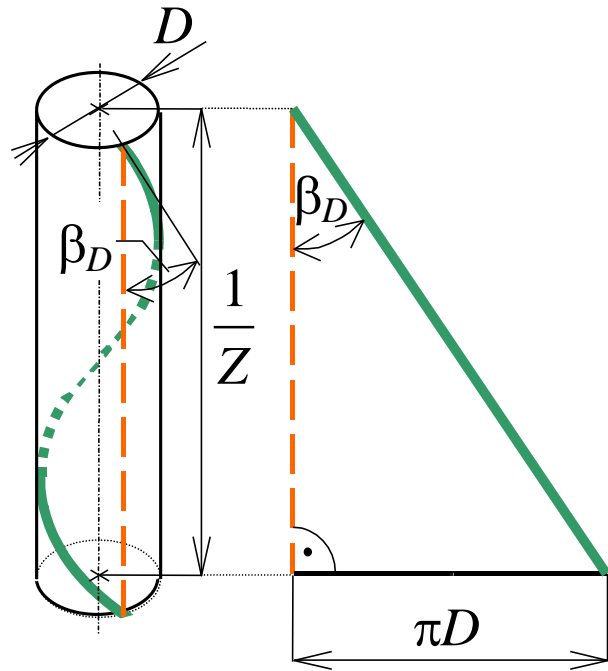
Ing. Bc Monika Vyšanská, PhD.

Thread - surface, identification

Surface structure of single length textiles - internal standards (see EXA_01):

- IN 22-102-01/01 Yarn diameter and hairiness

- IN 22-105-01/01 Rotor yarn belts.

- IN 22-105-01/02 Rotor yarn belts - modified version.

- IN 22-106-01/01 Determination of the covering of the core of the spun yarn.

- IN 32-102-01/01 Transverse dimensions of two ply yarn and diameter of single yarn, Longitudinal views

- IN 32-102-02/01 Geometric parameters of the spinning yarn skein.

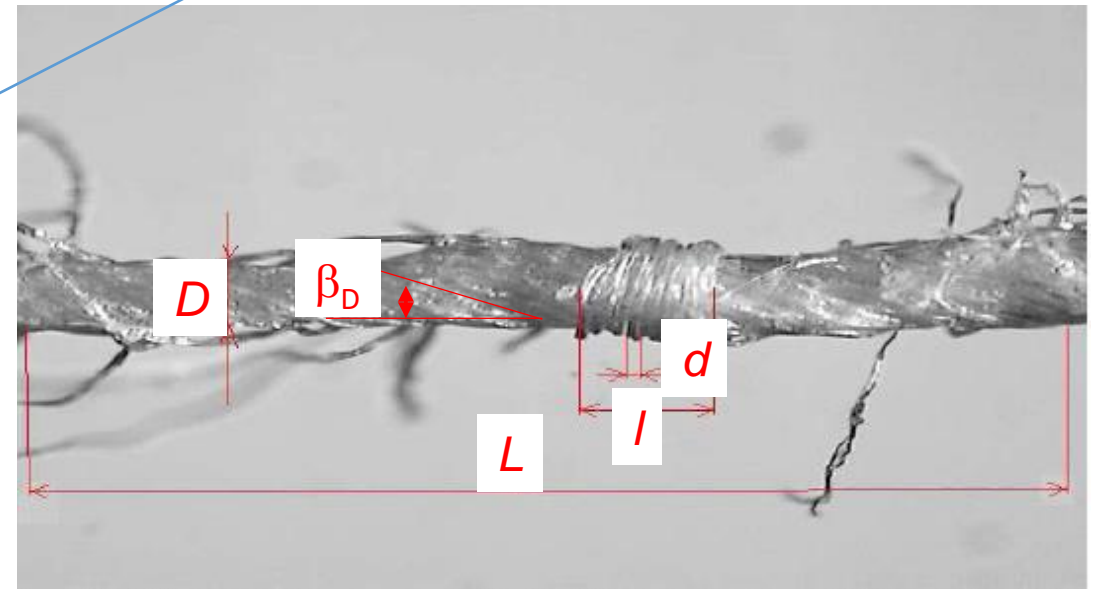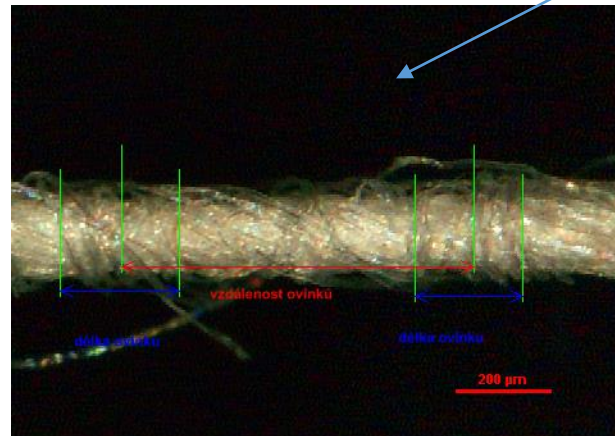- IN 42-102-01/01 Evaluation of yarn hairiness.
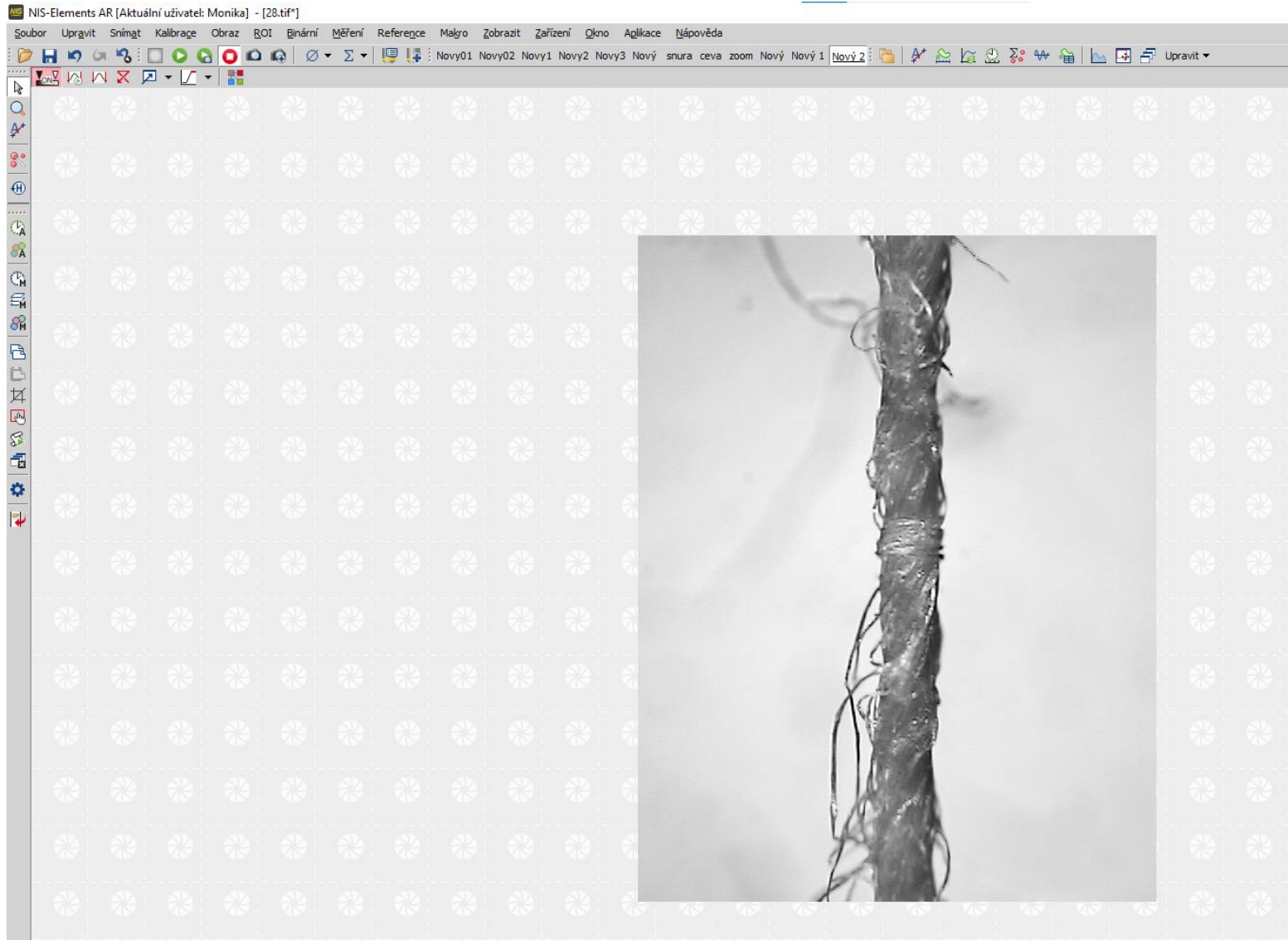
Detected parameters, see STR [1]:

$$\kappa = \pi D Z$$

$$\kappa = \tan \beta_D$$

+ hairiness - staple yarns
+ windingbelt fibers parameters - rotor yarns
+ tangle parameters - multifilament

Twist of yarn, multifilament - angle of inclination of surface fibre - by image analysis (example)
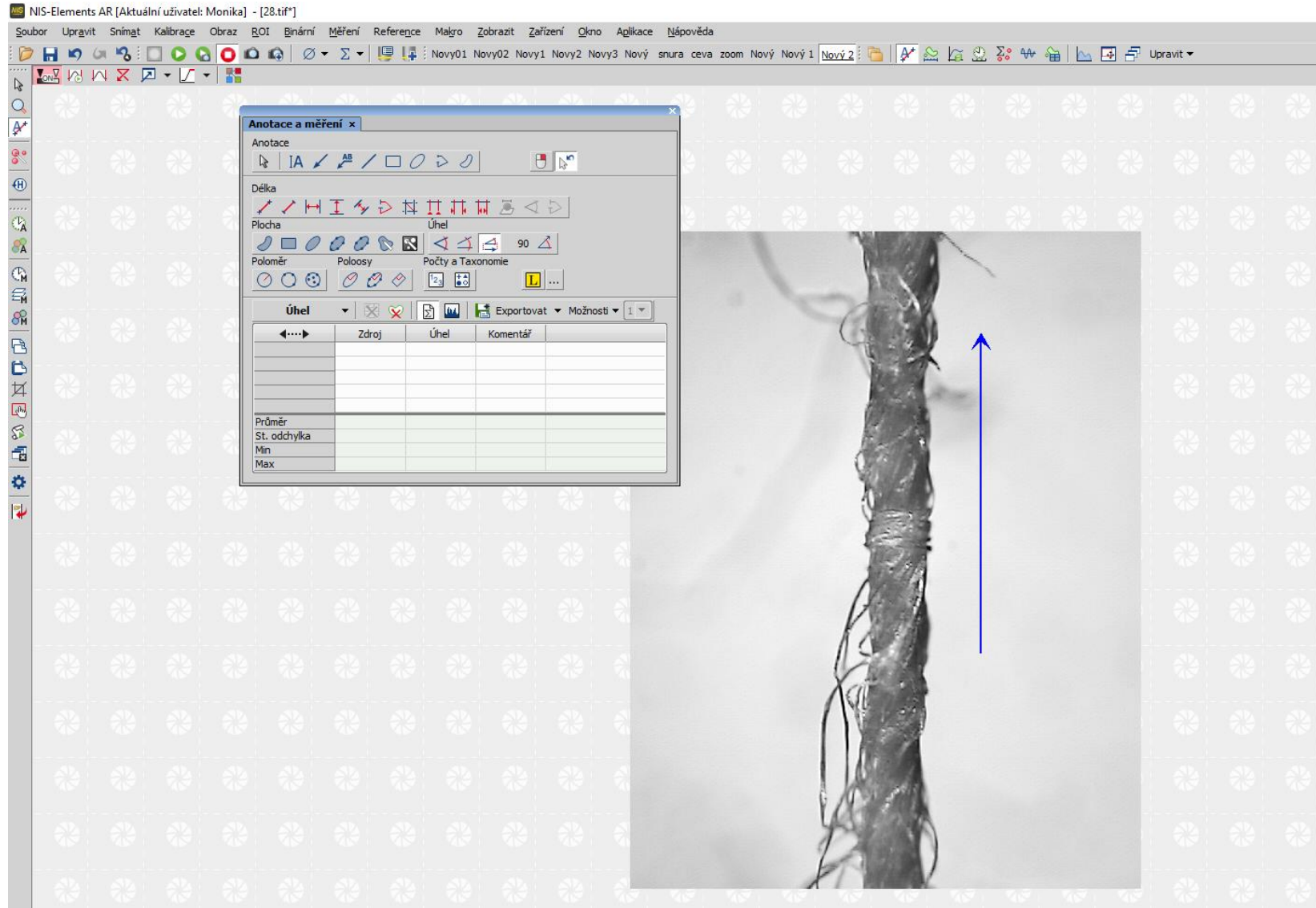
Twist of yarn, multifilament - angle of inclination of surface fibre - by image analysis (example)

Twist of yarn, multifilament - angle of inclination of surface fibre - by image analysis (example)

Yarn diameter, multifilament - from longitudinal views - using image analysis (interactive measurement demonstration)
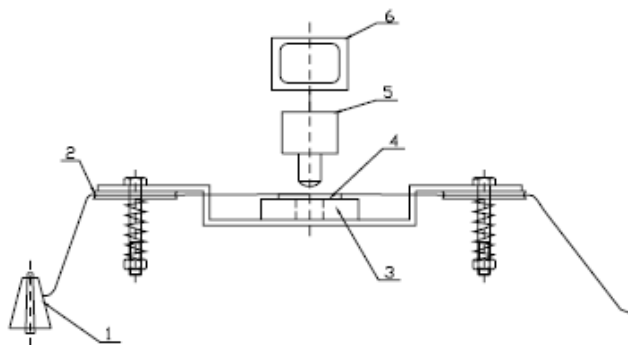
Yarn diameter, multifilament - from longitudinal views - using image analysis - other options

1. IN 22-102-01/01 Yarn diameter and hairiness

2. IN 32-102-01/01 Transverse dimensions of dtwo ply yarn and diameter of single yarn, Longitudinal views

1. IN 22-102-01/01 Yarn diameter and hairiness

Voborová, J., Neckář, B.

- This standard specifies a procedure for measuring yarn diameter and overall hairiness from longitudinal views of yarn using image analysis software. The input data for the method are a PC set of longitudinal views of yarn in the form of binary images. The method is suitable for single yarns in the fineness range 7-50 tex.

1- cívka s přízí
2- kotoučová brzdička
3- mostový vodič
4- objektiv mikroskopu
5- kamera
6- monitor počítače

Obr.2

Vyhodnoco-vaný řez - řádek pixelů

obr.1

Graf 1. Funkce chlupatosti

29,5 tex

20 tex

10 tex

2. IN 32-102-01/01 Cross dimensions of two-ply yarn and diameter of single yarn, Longitudinal views
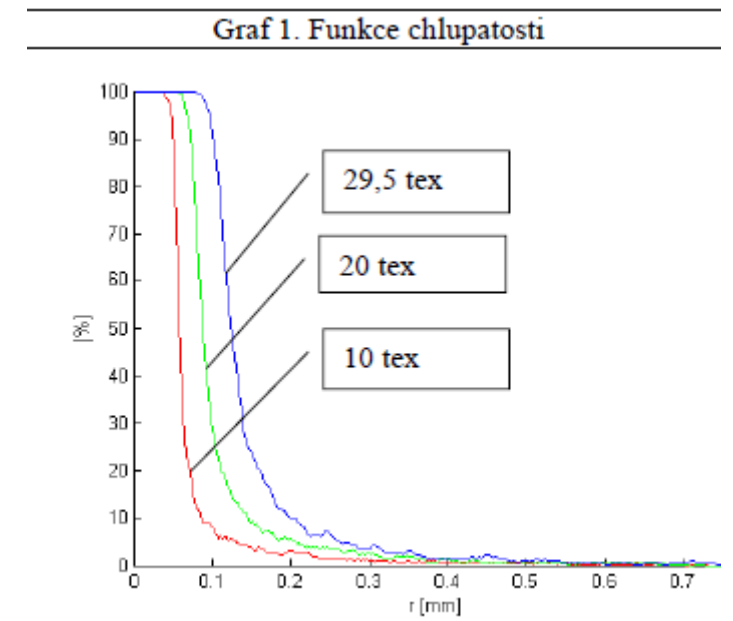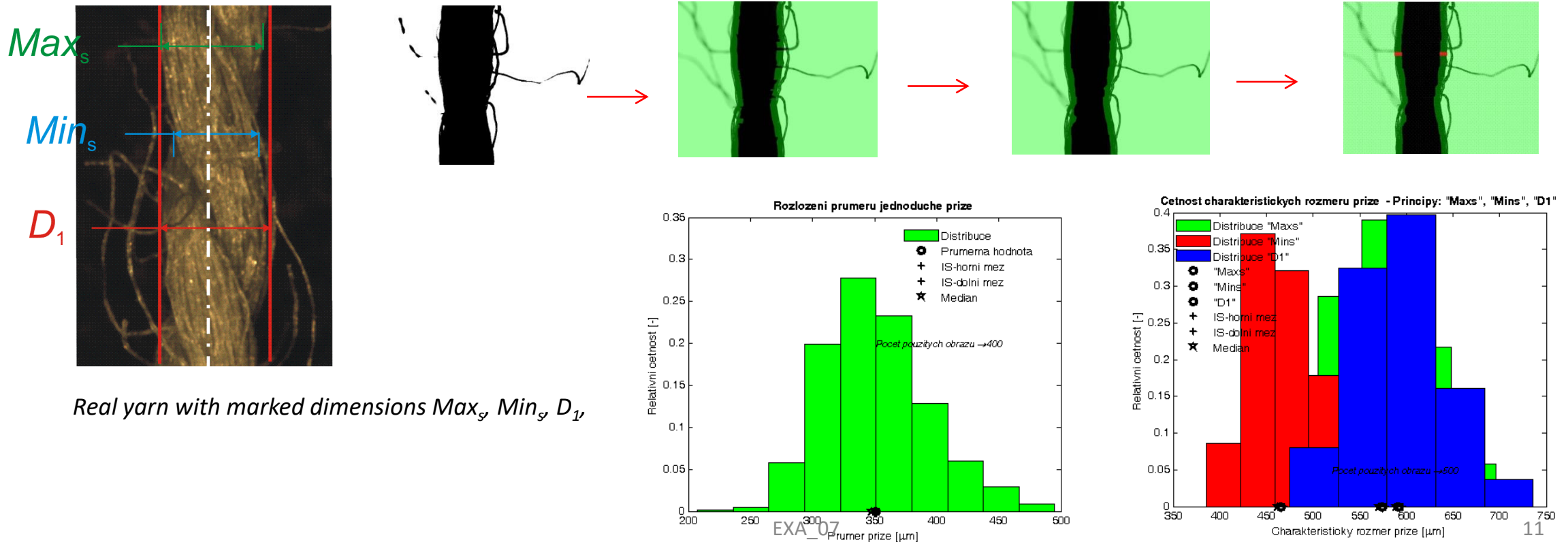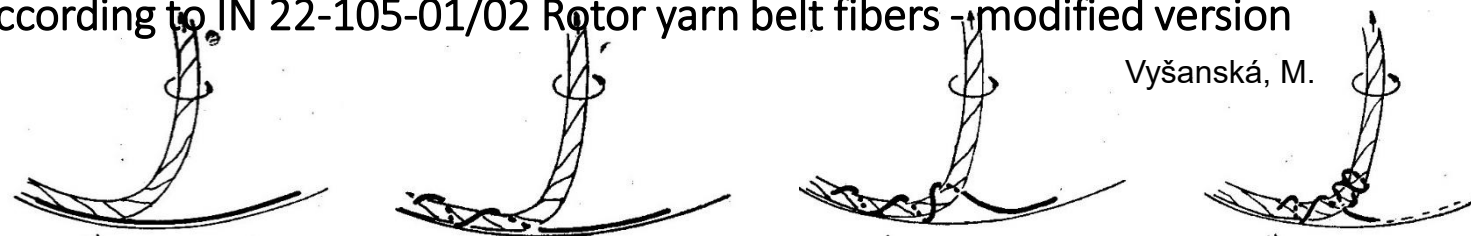
Vyšanská, M.

- This standard specifies the procedure for measuring the geometric parameters of two-ply yarn and single yarn diameter using image analysis software (e.g. NIS Elements) to obtain images and an evaluation program in the MatLab environment to obtain data and graphical output. The method is suitable for two-ply yarns and single yarns.

Max_s

Min_s

D_1

Real yarn with marked dimensions Max_s, Min_s, D_1,

Rozlozeni prumeru jednoduche prize

Distribuce
Prumerna hodnota
IS-horni mez
IS-dolni mez
Median

Pocet pouzitych obrazu →400

Relativni cetnost [-]

Prumer prize [µm]

Cetnost charakteristickych rozmeru prize - Principy: "Maxs", "Mins", "D1"

Distribuce "Maxs"
Distribuce "Mins"
Distribuce "D1"
"Maxs"
"Mins"
"D1"
IS-horni mez
IS-dolni mez
Median

Pocet pouzitych obrazu →500

Relativni cetnost [-]

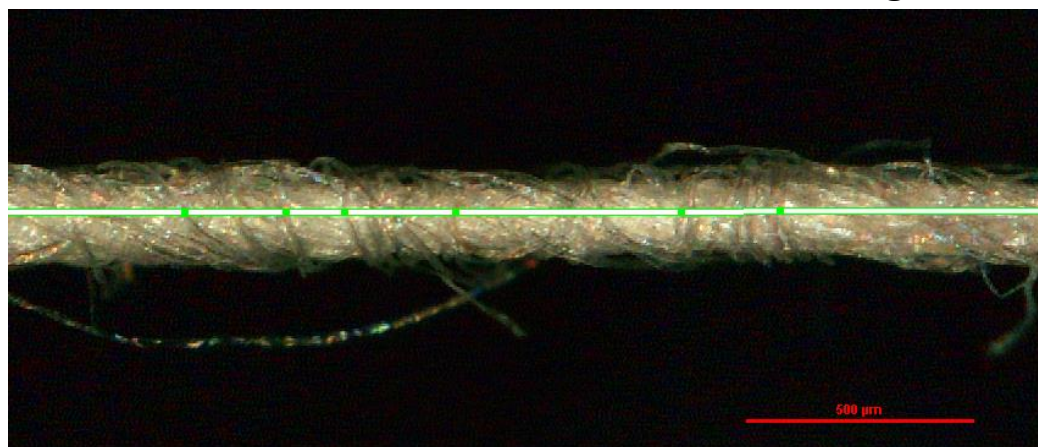Charakteristicky rozmer prize [µm]

EXA_07

Rotor yarn - belt fibers parameters according to IN 22-105-01/02 Rotor yarn belt fibers - modified version

Vyšanská, M.

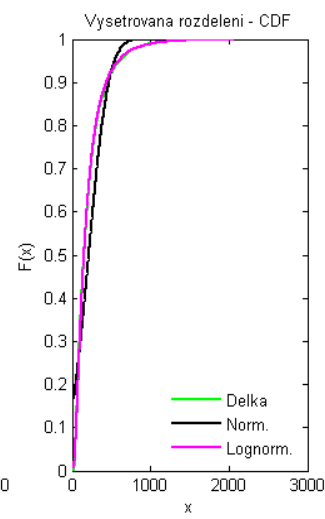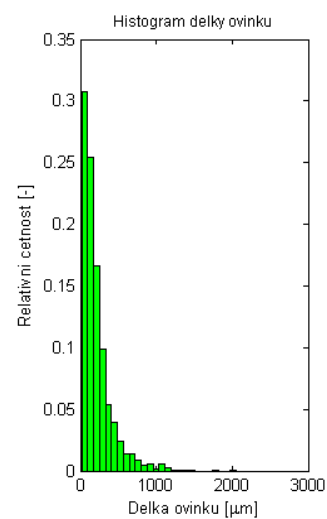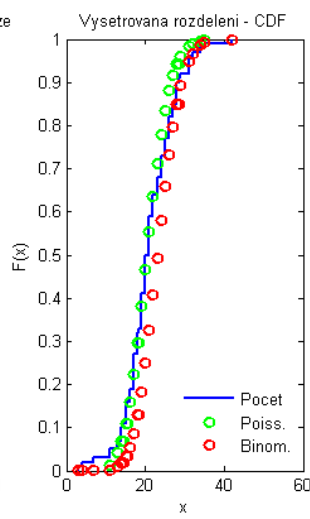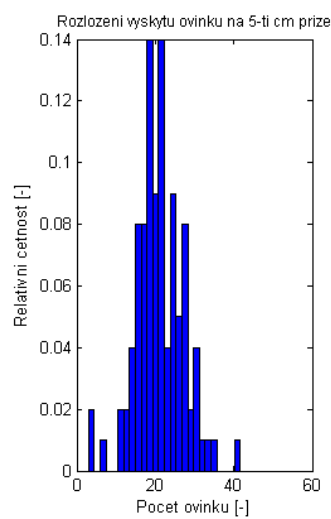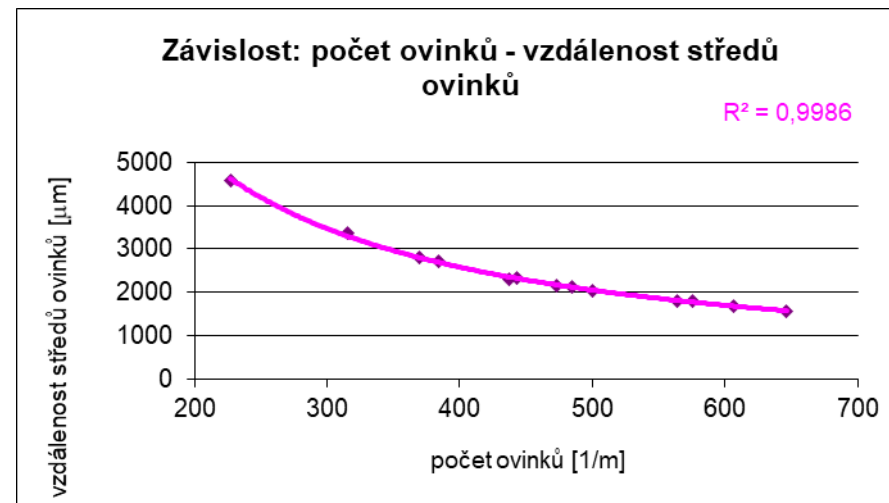## Creating of belt fibers on rotor yarn - individual stages
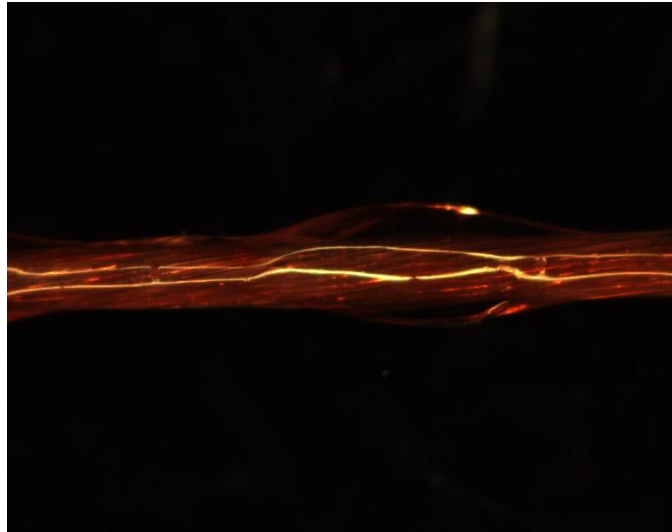

Ukázka označování ovinků

Experiment I - rotor yarn - belt fibers parameters

- 100% cotton yarn, (fineness 16,5tex, 20tex and 25tex - twist factor 75ktex2/3m-1 and 50tex fineness - 80ktex2/3m-1)
- three types of spinning rotor surface treatment, with the 20tex fineness - the number of spinning rotor surface treatments extended to four
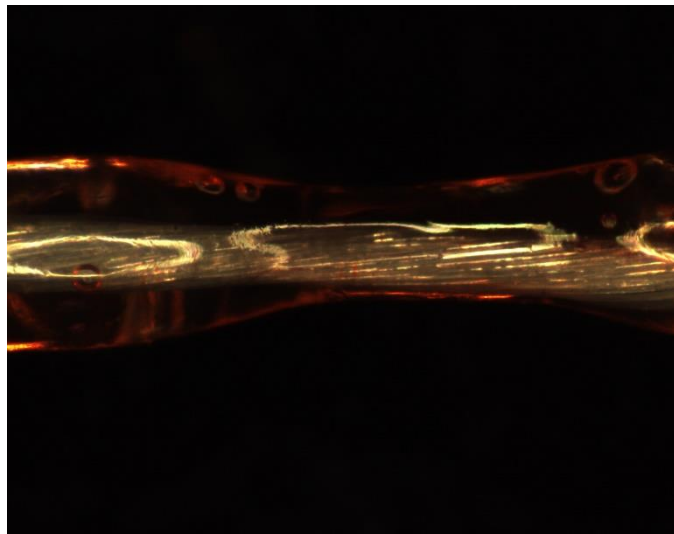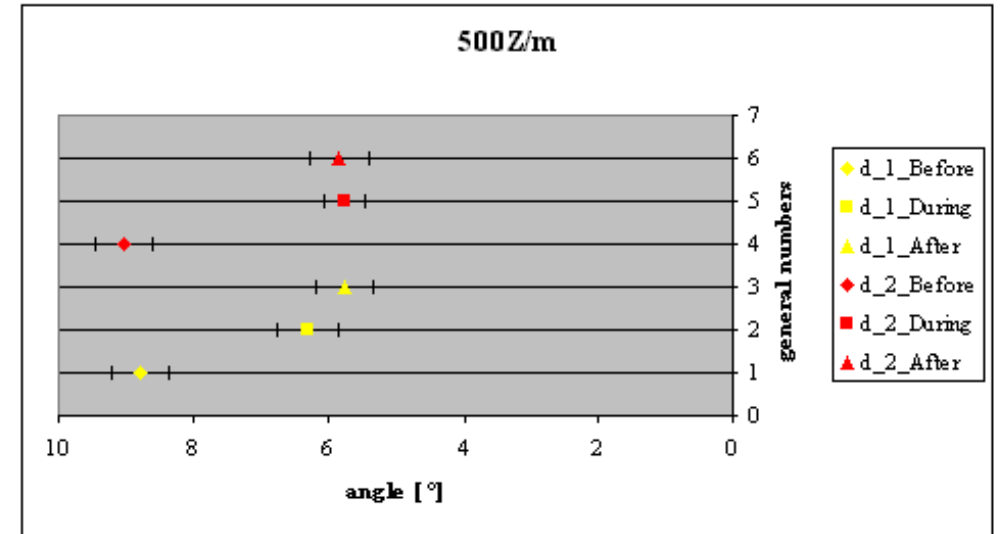
Yarn		559a	559b	559d	560a	560b	560c	560d	561a	561b	561d	562a	562b	562d
Nominal fineness	**[tex]**	**16,5**	**16,5**	**16,5**	**20**	**20**	**20**	**20**	**25**	**25**	**25**	**50**	**50**	**50**
Number of belt fibers	**[1/m]**	**437,14**	**443,3**	**384,21**	**227,4**	**315,25**	**369,92**	**500,58**	**473,22**	**576**	**606,02**	**485,01**	**646,28**	**564,25**
Standard deviation	[1/m]	20,90	21,05	19,60	15,07	17,75	19,23	22,37	21,75	24	24,61	22,02	25,42	23,75
Length of belt fiber	**[mm]**	**213,39**	**195,5**	**205,82**	**488,24**	**357,77**	**253**	**205,79**	**159,04**	**125,24**	**117,8**	**279,45**	**266,39**	**324,88**
Standard deviation	[mm]	14,60	13,98	14,34	22,09	18,91	15,90	14,34	12,61	11,19	10,85	16,71	16,32	18,02
Distance of belt fibers	**[mm]**	**2304,5**	**2324,1**	**2702,5**	**4579**	**3360,3**	**2808,2**	**2045,8**	**2143,9**	**1803,4**	**1684,1**	**2112,6**	**1553,2**	**1810,6**
Standard deviation	[mm]	48,00	48,20	51,98	67,66	57,96	52,99	45,23	46,30	42,46	41,03	45,96	39,41	42,55
Yarn covering by belt fibers	**[%]**	**0,41557**	**0,38819**	**0,41141**	**1,0133**	**0,76299**	**0,50941**	**0,40178**	**0,31103**	**0,25795**	**0,23804**	**0,54559**	**0,51359**	**0,63515**
Standard deviation	[%]	0,64	0,62	0,64	1,00	0,87	0,71	0,63	0,55	0,50	0,48	0,73	0,71	0,79

Závislost: zakrytí příze ovinky - délka ovinků
R² = 0,9938
délka ovinků [μm] vs zakrytí příze ovinky [%]

Závislost: počet ovinků - vzdálenost středů ovinků
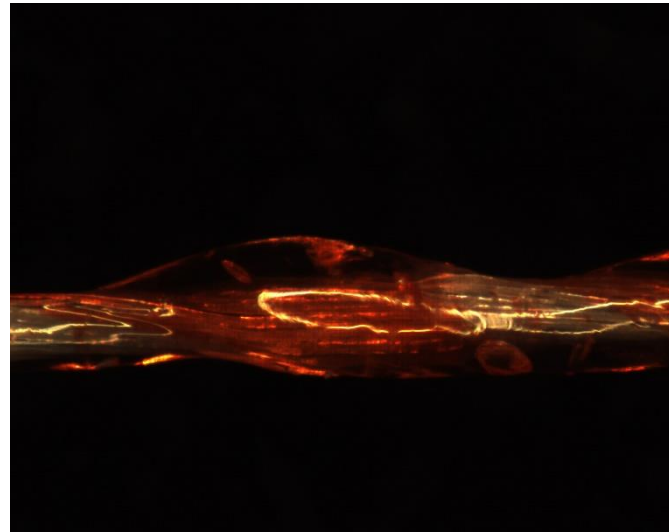R² = 0,9986
vzdálenost středů ovinků [μm] vs počet ovinků [1/m]

Experiment II - multifil - stabilizing the twist with glue

Multifil (500 1/m) stabilized with adhesive in two steps, (DWG+CWG)

500 Z/m

Legend: d_1_Before, d_1_During, d_1_After, d_2_Before, d_2_During, d_2_After

angle [°]

general numbers

Stabilization by the given means was insufficient...

Multifil (500 1/m) after relaxation, (DWG+CWG)

Multifil (500 1/m) after untwisting, (DWG+CWG)

EXA_07

14

Experiment III - evaluation of yarn diameter by **four** methodologies + comparison with theoretical calculation
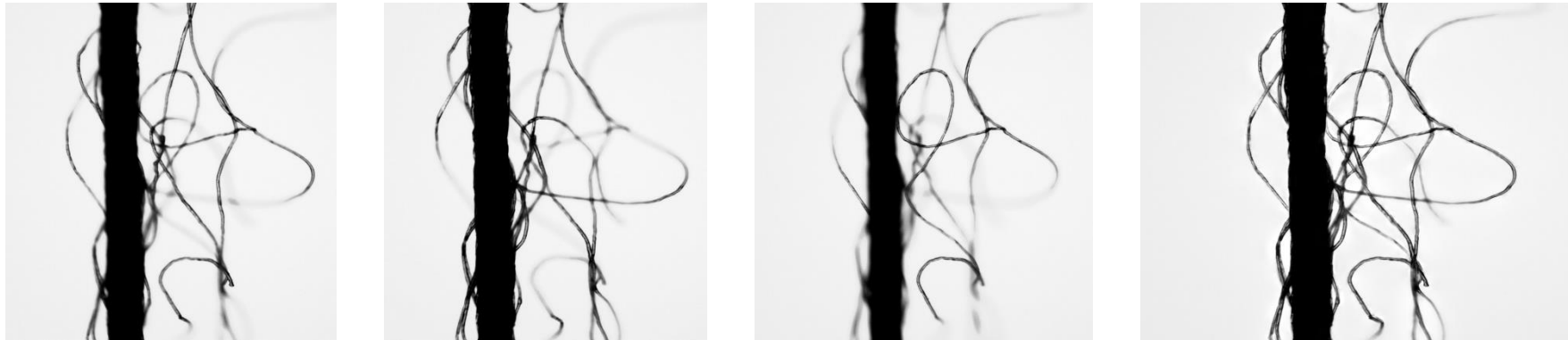
$$D_s = \sqrt{4S/\pi} = \sqrt{4T/\pi\rho}$$

1. **IN 22-102-01/01 Yarn diameter and hairiness**
2. **IN 32-102-01/01 Transverse dimensions of two-ply yarn and diameter of single yarn, Longitudinal views**
3. IN 22-103-01/01 Yarn packing density, Direct method and Secant method
4. IN 22-102-02/01 Transverse dimensions of two ply yarn and diameter of single yarn. Cross-sections.

Yarns tested: 100% cotton rotor yarns with finenesses of 14.5tex, 20tex, 35.5tex, 50tex and 72tex and a twist factor of 85ktex$^{2/3}$m^{-1}.
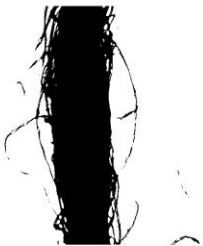
Experiment IV - Yarn hairiness
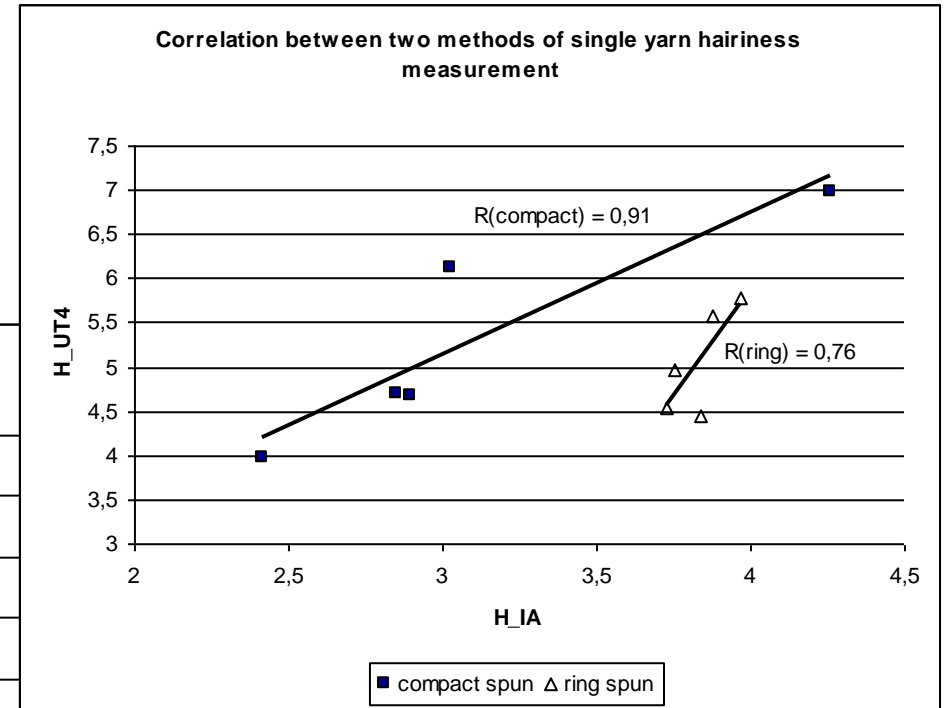
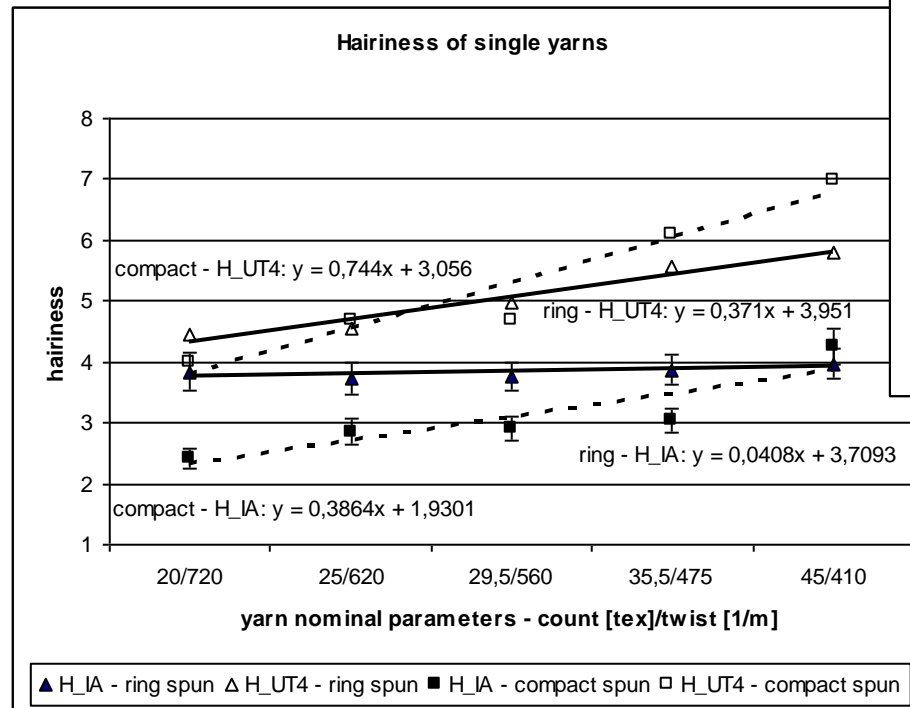Capture principle (you know from the EXA_04 lecture - using the EDF module)
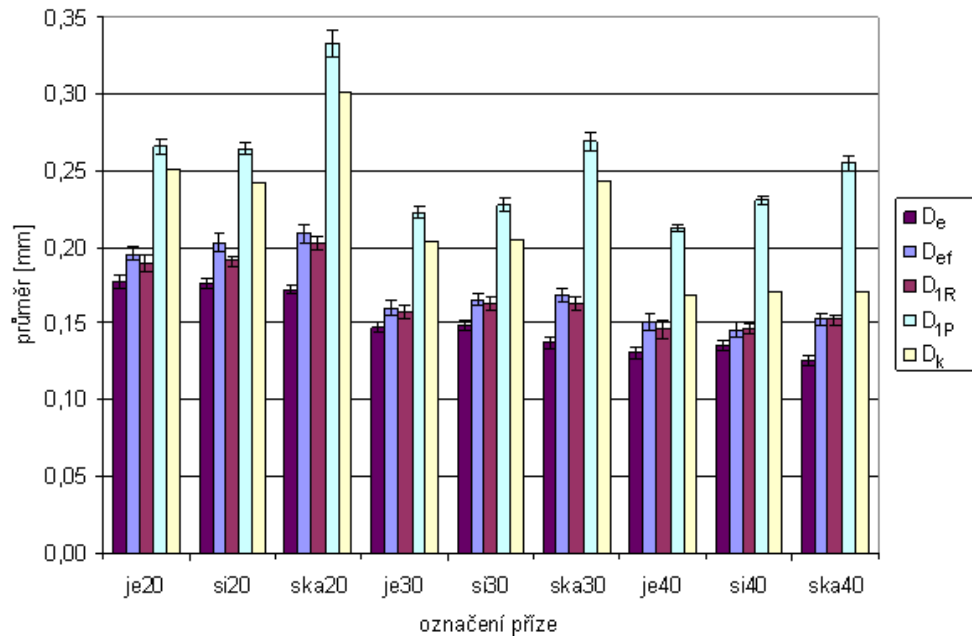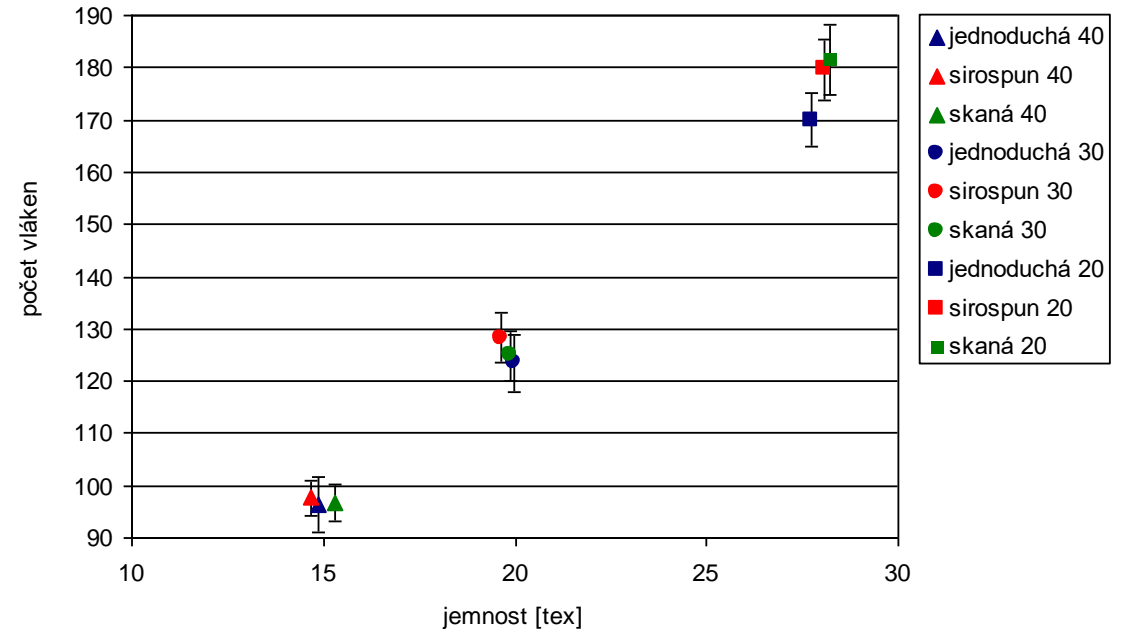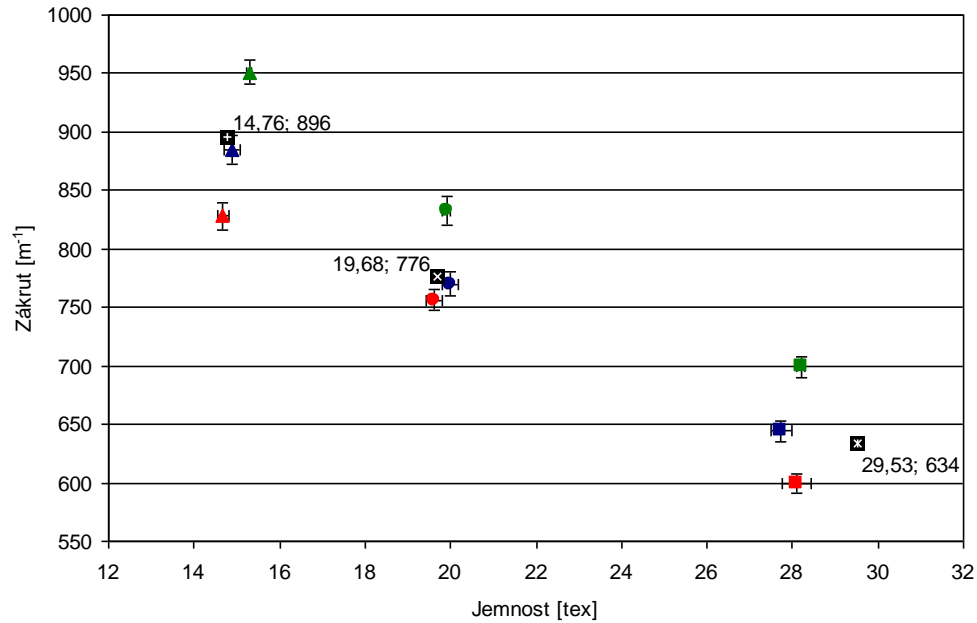

The principle of image processing

Experiment IV - yarn hairiness (continued)

Single yarn	
Ring spun yarn T [tex]/Z [1/m]	Compact spun yarn T [tex]/Z [1/m]
20/720	20/720
25/620	25/620
29,5/560	29,5/560
35,5/475	35,5/475
45/410	45/410

Correlation between two methods of single yarn hairiness measurement

R(compact) = 0,91

R(ring) = 0,76

H_UT4 (y-axis)
H_IA (x-axis)

■ compact spun △ ring spun

Hairiness of single yarns

compact - H_UT4: y = 0,744x + 3,056

ring - H_UT4: y = 0,371x + 3,951

ring - H_IA: y = 0,0408x + 3,7093

compact - H_IA: y = 0,3864x + 1,9301

hairiness (y-axis)

yarn nominal parameters - count [tex]/twist [1/m] (x-axis)

▲ H_IA - ring spun △ H_UT4 - ring spun ■ H_IA - compact spun □ H_UT4 - compact spun

Experiment V - diameter, packing density

D_e equivalent diameter from IA - cross sections

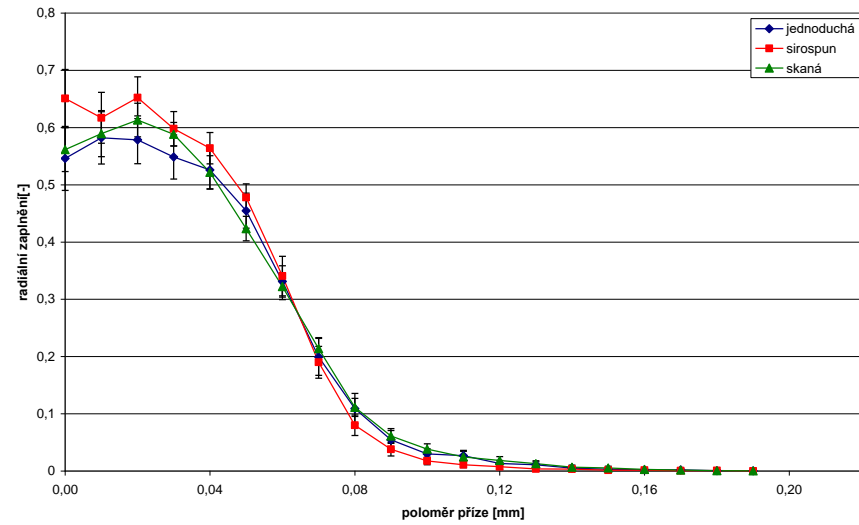D_{ef} effective diameter - equivalent to 0.15 of packing density - cross sections

D_{1R} maximum dimension from IA - cross-sections

D_{1P} diameter of the smallest cylinder into which the two-ply yarn will fit - longitudinal views
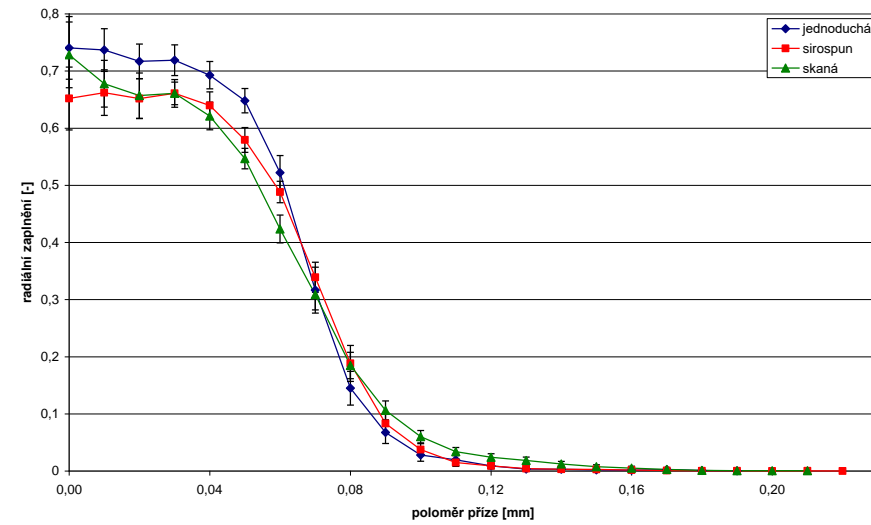
D_k covering diameter - corresponding to 50% blackening - longitudinal views

EXA_07

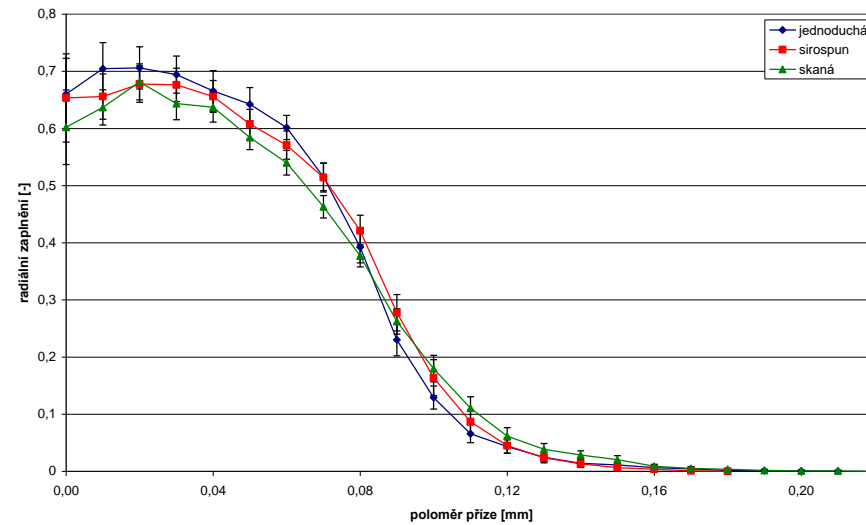# Experiment V - diameter, packing density (continued)

Zaplnění - příze 40

Zaplnění - příze 30

Zaplnění - příze 20

References used:

1. Bohuslav Neckář: PŘÍZE A HEDVÁBÍ 1, TU Liberec, KTT, power point prezentace pro předmět STR

2. Neckář, B.: Příze – struktura, vlastnosti, výroba, SNTL, Praha, 1991

3. Výběr interních norem KTT – viz text prezentace

4. Výběr publikací a zpráv autorky, práce vedené autorkou