Annex A

Needle penetration: Experimental data

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1. **Part 1 - Needle size**

The following sections display the complete set of results obtained in part 1 of the experiment. Values of average and energy have not been found useful and thus not been analysed, but they are provided here for reference. Power is not included because it differs from energy only by a scale factor.

In the sections concerning the subsequent parts of the experiment, only the data concerning peaks and valleys will be listed.

### 1.1. Without thread - Spectral filtering - Zero correction

This section shows the results obtained after processing the signals acquired without thread.

Processing was carried out using spectral filtering with a 0-1-3 stopband and feature extraction with zero correction.

**Conditions**
- Experimentation Part 1
- New light ball point needles of sizes 60, 70, 80, 100 and 120
- No thread
- Finished fabric
- Sewing speeds 1000 and 3500 spm
1.1.1. Peaks and Valleys - Summary

Peaks and valleys, spectral filtering, no thread

![Graph showing peaks and valleys](image)

Annex A - Results of experiment part 1
1.1.2. Peaks and valleys - 1000 spm

3D-representation, XY and YZ projections

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm
Peaks and valleys - Chronological sequence and average values

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Peaks and valleys - Standard deviation and coefficient of variation

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Annex A - Results of experiment part 1
Peak ratios - Chronological sequence and average values

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Peak ratios - Standard deviation and coefficient of variation

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
1.1.3. Peaks and valleys - 3500 spm

3D-representation, XY and YZ projections and projections

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm
Peaks and valleys - Chronological sequence and average values

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Peaks and valleys - Standard deviation and coefficient of variation

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Correlation between peaks

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm
Peak ratios – Chronological sequence and average values

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Peak ratios - Standard deviation and coefficient of variation

Without thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
1.1.4. Phase average -1000 spm

**3D-representation, XY and YZ projections**

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1
Phase average - Chronological sequence and average values

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average - Standard deviation and coefficient of variation

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Correlation between phase averages

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average ratios - Chronological sequence and average values

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average ratios - Standard deviation and coefficient of variation

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
1.1.5. Phase average - 3500 spm

**3D-representation, XY and YZ projections**

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Phase average - Chronological sequence and average values

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Phase average - Standard deviation and coefficient of variation

Without thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Correlation between phase averages

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Phase average ratios - Chronological sequence and average values

Annex A – Results of experiment part 1
Phase average ratios - Standard deviation and coefficient of variation

Without thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
1.1.6. Energy -1000 spm

3D-representation, XY and YZ projections

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm
Energy - Chronological sequence and average values

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Energy - Standard deviation and coefficient of variation

Annex A – Results of experiment part 1

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm
Correlation between energy values

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1
**Energy ratios - Chronological sequence and average values**

<table>
<thead>
<tr>
<th>Without thread</th>
<th>Spectral Filtering</th>
<th>Zero Correction</th>
<th>Speed: 1000 spm</th>
</tr>
</thead>
<tbody>
<tr>
<td>60/1000</td>
<td>70/1000</td>
<td>80/1000</td>
<td>100/1000</td>
</tr>
<tr>
<td>120/1000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Energy ratios - Standard deviation and coefficient of variation

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
1.1.7. Energy - 3500 spm

3D-representation, XY and YZ projections

Without thread – Spectral Filtering – Zero Correction – Speed: 3500 spm
Energy - Chronological sequence and average values

Without thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Energy - Standard deviation and coefficient of variation

Annex A - Results of experiment part 1

Without thread - Spectral Filtering - Zero Correction - Speed: 3500 spm
Correlation between energy values

Without thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Energy ratios - Chronological sequence and average values

Without thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Energy ratios - Standard deviation and coefficient of variation

Without thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
1.2. With thread - Spectral filtering - Zero correction

This section shows the results obtained after processing the signals acquired with thread. Processing was carried out using spectral filtering with a 0-1-3 stopband and feature extraction with zero correction.

Conditions

- Experimentation Part 1
- New light ball point needles of sizes 60, 70, 80, 100 and 120
- Thread according to needle size (see chapter VI-2.1, Table VI-1)
- Finished fabric
- Sewing speeds 1000 and 3500 spm
1.2.1. Peaks and valleys - Summary

Peaks and valleys, spectral filtering, with thread

Force [cN]

60 70 80 100 120 120-II 60 70 80 100 120 120-II 60 70 80 100 120 120-II

Peak1 Peak2 Valley3

Annex A - Results of experiment part 1
1.2.2. Peaks and valleys - 1000 spm

3D-representation, XY and YZ projections

With thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Peaks and valleys - Chronological sequence and average values

With thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Peaks and valleys - Standard deviation and coefficient of variation

With thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Correlation between peaks

With thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Peak ratios - Chronological sequence and average values

With thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Peak ratios - Standard deviation and coefficient of variation

With thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
1.2.3. Peaks and valleys -3500 spm

**3D-representation, XY and YZ projections**

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Peaks and valleys - Chronological sequence and average values

Annex A - Results of experiment part 1
Peaks and valleys - Standard deviation and coefficient of variation

With thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Correlation between peaks

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Peak ratios - Chronological sequence and average values

With thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Annex A - Results of experiment part 1

**Peak ratios - Standard deviation and coefficient of variation**

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm
1.2.4. Phase average -1000 spm

3D-representation, XY and YZ projections

With thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average - Chronological sequence and average values

With thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average - Standard deviation and coefficient of variation

With thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1
Correlation between phase averages

With thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1
Phase average ratios - Chronological sequence and average values

With thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average ratios - Standard deviation and coefficient of variation

With thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
1.2.5. Phase average -1000 spm
3D-representation, XY and YZ projections

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Phase average - Chronological sequence and average values

With thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Phase average - Standard deviation and coefficient of variation

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Correlation between phase averages

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Phase average ratios - Chronological sequence and average values

With thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Phase average ratios - Standard deviation and coefficient of variation

With thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
1.2.6. Energy -1000 spm

3D-representation, XY and YZ projections

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1
Energy - Chronological sequence and average values

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Correlation between energy values

Without thread – Spectral Filtering – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1
Energy ratios - Chronological sequence and average values

Without thread - Spectral Filtering - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Annex A - Results of experiment part 1
1.2.7. Energy -3500 spm

3D-representation, XY and YZ projections

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm
Energy - Chronological sequence and average values

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Energy - Standard deviation and coefficient of variation

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Correlation between energy values

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Energy ratios - Chronological sequence and average values

With thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Energy ratios - Standard deviation and coefficient of variation

With thread - Spectral Filtering - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
13. **Without thread - Referenced subtraction - Zero correction**

This section shows the results obtained after processing the signals acquired **without thread**. Processing was carried out using **referenced subtraction of a void signal** and feature extraction with **zero correction**.

**Conditions**
- **Experimentation Part 1**
- New light ball point needles of sizes 60, 70, 80, 100 and 120
- No thread
- Finished fabric
- Sewing speeds 1000 and 3500 spm
1.3.1. Peaks and valleys - Summary

Peaks and valleys, referenced subtraction, no thread

Force [cN]

Annex A - Results of experiment part 1
1.3.2. Peaks and valleys -1000 spm

**3D-representation, XY and YZ projections**

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Peaks and valleys - Chronological sequence and average values

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Peaks and valleys - Standard deviation and coefficient of variation

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Correlation between peaks

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1
Peak ratios - Chronological sequence and average values

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Peak ratios - Standard deviation and coefficient of variation

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
1.3.3. Peaks and valleys - 3500 spm

3D-representation, XY and YZ projections

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Peaks and valleys - Chronological sequence and average values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Peaks and valleys - Standard deviation and coefficient of variation

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Correlation between peaks

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Peak ratios – Chronological sequence and average values

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm

Annex A – Results of experiment part 1

AA-94
Peak ratios - Standard deviation and coefficient of variation

With thread – Spectral Filtering – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
1.3.4. Phase average -1000 spm

**3D-representation, XY and YZ projections**

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average - Chronological sequence and average values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average - Standard deviation and coefficient of variation

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Correlation between phase averages

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1

AA-99
Phase average ratios - Chronological sequence and average values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Phase average ratios - Standard deviation and coefficient of variation

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
1.3.5. Phase average -3500 spm

3D-representation, XY and YZ projections

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm
Phase average - Chronological sequence and average values

Annex A - Results of experiment part 1

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 3500 spm
Phase average - Standard deviation and coefficient of variation

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1

AA-104
Correlation between phase averages

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Phase average ratios - Chronological sequence and average values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Phase average ratios - Standard deviation and coefficient of variation

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
1.3.6. Energy -1000 spm

3D-representation, XY and YZ projections

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A – Results of experiment part 1  

AA-108
Energy - Chronological sequence and average values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Energy - Standard deviation and coefficient of variation

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Correlation between energy values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Energy ratios - Chronological sequence and average values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Energy ratios - Standard deviation and coefficient of variation

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 1000 spm

Annex A - Results of experiment part 1
1.3.7. Energy -3500 spm

3D-representation, XY and YZ projections

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm
Energy - Chronological sequence and average values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Energy - Standard deviation and coefficient of variation

Annex A - Results of experiment part 1

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 3500 spm
Correlation between energy values

Without thread – Referenced subtraction of void signal – Zero Correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Energy ratios - Chronological sequence and average values

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 3500 spm

Annex A – Results of experiment part 1
Annex A - Results of experiment part 1

Energy ratios - Standard deviation and coefficient of variation

Without thread - Referenced subtraction of void signal - Zero Correction - Speed: 3500 spm
1.4. Without thread - Spectral filtering - Zero correction - Correction with neural network

This section shows the results obtained after processing the signals acquired without thread. Processing was carried out using spectral filtering, feature extraction with zero correction and subsequent neural correction of values.

Conditions

- Experimentation Part 1
- New light ball point needles of sizes 60, 70, 80, 100 and 120
- No thread
- Finished fabric
- Sewing speeds 1000 and 3500 spm
1.4.1. Peaks and valleys - Summary

Peaks and valleys, neural correction, no thread

Annex A - Results of experiment part 1
1.4.2. Peaks and valleys - 1000 spm

3D-representation, XY and YZ projections

Without thread – Spectral filtering – Zero correction – Neural correction – Speed: 1000 spm

Annex A - Results of experiment part 1
Peaks and valleys - Chronological sequence and average values

Without thread - Spectral filtering - Zero correction - Neural correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Peaks and valleys - Standard deviation and coefficient of variation

Without thread - Spectral filtering - Zero correction - Neural correction - Speed: 1000 spm

Annex A - Results of experiment part 1
Correlation between peaks

Without thread – Spectral filtering – Zero correction – Neural correction – Speed: 1000 spm

Annex A – Results of experiment part 1
Peak ratios - Chronological sequence and average values

Annex A – Results of experiment part 1
Peak ratios - Standard deviation and coefficient of variation

Without thread - Spectral filtering - Zero correction - Neural correction - Speed: 1000 spm

Annex A - Results of experiment part 1
1.4.3. Peaks and valleys - 3500 spm

**3D-representation, XY and YZ projections**

Without thread – Spectral filtering – Zero correction – Neural correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Peaks and valleys - Chronological sequence and average values

Without thread – Spectral filtering – Zero correction – Neural correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Peaks and valleys - Standard deviation and coefficient of variation

Without thread - Spectral filtering - Zero correction - Neural correction - Speed: 3500 spm

Annex A - Results of experiment part 1
Correlation between peaks

Without thread – Spectral filtering – Zero correction – Neural correction – Speed: 3500 spm

Annex A – Results of experiment part 1
Peak ratios - Chronological sequence and average values

Without thread – Spectral filtering – Zero correction – Neural correction – Speed: 3500 spm

Annex A - Results of experiment part 1
Peak ratios - Standard deviation and coefficient of variation

Without thread - Spectral filtering - Zero correction - Neural correction - Speed: 3500 spm

Annex A - Results of experiment part 1
2. Part 2 - Fabric finishing

In this part, only the data concerning peaks and valleys is listed.

2.1. Withoutthread - Spectral Filtering - Zero correction

This section shows the results obtained after processing the signals acquired without thread.

Processing was carried out using spectral filtering with a 0-1-3 stopband and feature extraction with zero correction.

Conditions
- Experimentation Part 2
- New light ball point needles of sizes 70 and 120
- 150 thread for both needle sizes
- Raw, dyed and finished fabric
- Sewing speeds 1000 and 3500 spm
2.1.1. Peaks and valleys – Summary

Peaks and valleys, spectral filtering, no thread

<table>
<thead>
<tr>
<th>Force [cN]</th>
<th>Raw</th>
<th>Dyed</th>
<th>Finished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak1</td>
<td>70/1000</td>
<td>70/3500</td>
<td>120/1000</td>
</tr>
<tr>
<td>Peak2</td>
<td>70/1000</td>
<td>70/3500</td>
<td>120/3500</td>
</tr>
<tr>
<td>Valley3</td>
<td>70/1000</td>
<td>70/3500</td>
<td>120/3500</td>
</tr>
</tbody>
</table>

Annex A - Results of experiment part 2
Annex A - Results of experiment part 2
2.1.2. Peaks and valleys - 1000 spm

3D-representation, XY and YZ projections

Without thread – Spectral filtering – Zero correction – Speed: 1000 spm

Annex A – Results of experiment part 2
Peaks and valleys - Chronological sequence and average values

Without thread – Spectral filtering – Zero correction – Speed: 1000 spm

Annex A - Results of experiment part 2
Peaks and valleys - Standard deviation and coefficient of variation

Annex A - Results of experiment part 2

Without thread - Spectral filtering - Zero correction - Speed: 1000 spm

Annex A - Results of experiment part 2
Correlation between peaks

Without thread – Spectral filtering – Zero correction – Speed: 1000 spm

Annex A – Results of experiment part 2
Annex A - Results of experiment part 2
Annex A - Results of experiment part 2
2.1.3. Peaks and valleys - 3500 spm

3D-representation, XY and YZ projections

Without thread – Spectral filtering – Zero correction – Speed: 3500 spm

Annex A - Results of experiment part 2
Peaks and valleys - Chronological sequence and average values

Without thread - Spectral filtering - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Peaks and valleys - Standard deviation and coefficient of variation

Without thread - Spectral filtering - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Correlation between peaks

Without thread – Spectral filtering – Zero correction – Speed: 3500 spm

Annex A – Results of experiment part 2
Peak ratios - Chronological sequence and average values

Without thread - Spectral filtering - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Legend:
- Finished/70
- Finished/120
- Dyed/70
- Dyed/120
- Raw/70
- Raw/120

Without thread - Spectral filtering - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
2.2. With thread - Spectral Filtering - Zero correction

This section shows the results obtained after processing the signals acquired with thread.

Processing was carried out using spectral filtering with a 0-1-3 stopband and feature extraction with zero correction.

Conditions
- Experimentation Part 2
- New light ball point needles of sizes 70 and 120
- 150 thread for both needle sizes
- Raw, dyed and finished fabric
- Sewing speeds 1000 and 3500 spm
2.2.1. Peaks and valleys - Summary

Peaks and valleys, spectral filtering, threaded

<table>
<thead>
<tr>
<th>Force [cN]</th>
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<tbody>
<tr>
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<tr>
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<tr>
<td>1500</td>
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<tr>
<td>1000</td>
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<tr>
<td>500</td>
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<tr>
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<table>
<thead>
<tr>
<th>Process</th>
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</thead>
<tbody>
<tr>
<td>Raw Peak1</td>
<td>70/1000</td>
</tr>
<tr>
<td>Dyed Peak1</td>
<td>70/3500</td>
</tr>
<tr>
<td>Finished Peak1</td>
<td>120/1000</td>
</tr>
<tr>
<td>Raw Peak2</td>
<td>70/1000</td>
</tr>
<tr>
<td>Dyed Peak2</td>
<td>70/3500</td>
</tr>
<tr>
<td>Finished Peak2</td>
<td>120/3500</td>
</tr>
<tr>
<td>Raw Valley3</td>
<td>70/1000</td>
</tr>
<tr>
<td>Dyed Valley3</td>
<td>70/3500</td>
</tr>
<tr>
<td>Finished Valley3</td>
<td>120/3500</td>
</tr>
</tbody>
</table>
2.2.2. Peaks and valleys - 1000 spm

3D-representation, XY and YZ projections

With thread - Spectral filtering - Zero correction - Speed: 1000 spm

Annex A - Results of experiment part 2
Peaks and valleys - Chronological sequence and average values

With thread - Spectral filtering - Zero correction - Speed: 1000 spm

Annex A - Results of experiment part 2
Peaks and valleys - Standard deviation and coefficient of variation

With thread – Spectral filtering – Zero correction -Speed: 1000 spm

Annex A - Results of experiment part 2
Correlation between peaks

With thread – Spectral filtering – Zero correction – Speed: 1000 spm

Annex A - Results of experiment part 2
Peak ratios – Chronological sequence and average values

With thread – Spectral filtering – Zero correction– Speed: 1000 spm

Annex A - Results of experiment part 2
Peak ratios - Standard deviation and coefficient of variation

Data analysis with thread, spectral filtering, zero correction, and speed: 1000 spm

Annex A - Results of experiment part 2
2.2.3. Peaks and valleys-3500 spm

3D-representation, XY and YZ projections

With thread - Spectral filtering - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Peaks and valleys - Chronological sequence and average values

With thread - Spectral filtering - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Peaks and valleys - Standard deviation and coefficient of variation

With thread – Spectral filtering – Zero correction – Speed: 3500 spm

Annex A - Results of experiment part 2
Correlation between peaks

With thread - Spectral filtering - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Peak ratios – Chronological sequence and average values

With thread – Spectral filtering – Zero correction – Speed: 3500 spm

Annex A – Results of experiment part 2
Peak ratios - Standard deviation and coefficient of variation

With thread - Spectral filtering - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
2.3. Without thread - Referenced Subtraction - Zero correction

This section shows the results obtained after processing the signals acquired without thread. Processing was carried out using referenced subtraction and feature extraction with zero correction.

Conditions
- Experimentation Part 2
- New light ball point needles of sizes 70 and 120
- 150 thread for both needle sizes
- Raw, dyed and finished fabric
- Sewing speeds 1000 and 3500 spm
2.3.1. Peaks and valleys - Summary

Peaks and valleys, referenced subtraction, no thread

![Graph showing force in cN for raw, dyed, and finished states for Peak1, Peak2, and Valley3 with different conditions (70/1000, 70/3500, 120/1000, 120/3500).]
2.3.2. Peaks and valleys -1000 spm

Annex A - Results of experiment part 2

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3D-representation, XY and YZ projections

Without thread - Referenced Subtraction - Zero correction - Speed: 1000 spm

Annex A - Results of experiment part 2
Peaks and valleys - Chronological sequence and average values

Without thread – Referenced Subtraction – Zero correction – Speed: 1000 spm

Annex A – Results of experiment part 2
Peaks and valleys - Standard deviation and coefficient of variation

Without thread - Referenced Subtraction - Zero correction - Speed: 1000 spm

Annex A - Results of experiment part 2
Correlation between peaks

Without thread – Referenced Subtraction – Zero correction - Speed: 1000 spm

Annex A - Results of experiment part 2
Peak ratios - Chronological sequence and average values

Without thread - Referenced subtraction - Zero correction - Speed: 1000 spm

Annex A - Results of experiment part 2
Peak ratios - Standard deviation and coefficient of variation

Without thread - Referenced Subtraction - Zero correction - Speed: 1000 spm

Annex A - Results of experiment part 2
2.3.3. Peaks and valleys - 3500 spm

3D-representation, XY and YZ projections

Without thread - Referenced Subtraction - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Peaks and valleys - Chronological sequence and average values

Without thread - Referenced Subtraction - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Peaks and valleys - Standard deviation and coefficient of variation

Without thread – Referenced Subtraction – Zero correction – Speed: 3500 spm

Annex A – Results of experiment part 2
Correlation between peaks

Without thread - Referenced Subtraction - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
Without thread – Referenced subtraction – Zero correction – Speed: 3500 spm

Annex A - Results of experiment part 2
Peak ratios - Standard deviation and coefficient of variation

Without thread - Referenced Subtraction - Zero correction - Speed: 3500 spm

Annex A - Results of experiment part 2
3. Part 3 - Needle damage

In this part, only the data concerning peaks and valleys is listed.

3.1. Without thread - Spectral Filtering - Zero correction

This section shows the results obtained after processing the signals acquired without thread. Processing was carried out using spectral filtering with a 0-1-3 stopband and feature extraction with zero correction.

Conditions
- Experimentation Part 3
- New and damaged light ball point needles of sizes 80 and 120
- 150 thread for both needle sizes
- Dyed fabric
- Sewing speeds 1000 and 3500 spm
3.1.1. Peaks and valleys - Summary

Peaks and valleys, spectral filtering, no thread

Force [cN]

Annex A - Results of experiment part 3
Annex A - Results of experiment part 3

Peak ratios, spectral filtering, no thread

Ratio2/1 | Ratio3/1 | Ratio3/2
---|---|---
80New | 80Def | 120New | 120Def
3500 | 1000 | 3500 | 1000

3.1.2. Peaks and valleys

3D-representation, XY and YZ projections

Without thread – Spectral filtering – Zero correction

Annex A - Results of experiment part 3
Peaks and valleys - Chronological sequence and average values

Without thread – Spectral filtering – Zero correction

Annex A - Results of experiment part 3

AA-184
Peaks and valleys - Standard deviation and coefficient of variation

Without thread – Spectral filtering – Zero correction

Annex A – Results of experiment part 3
Correlation between peaks

Without thread – Spectral filtering – Zero correction

Annex A - Results of experiment part 3
Peak ratios - Chronological sequence and average values

Without thread - Spectral filtering - Zero correction

Annex A - Results of experiment part 3
Annex A - Results of experiment part 3
3.2. With thread - Spectral Filtering - Zero correction

This section shows the results obtained after processing the signals acquired with thread.

Processing was carried out using spectral filtering with a 0-1-3 stopband and feature extraction with zero correction.

Conditions

- Experimentation Part 2
- New and damaged light ball point needles of sizes 80 and 120
- 150 thread for both needle sizes
- Dyed fabric
- Sewing speeds 1000 and 3500 spm
3.2.1. Peaks and valleys - Summary

Peaks and valleys, spectral filtering, with thread

<table>
<thead>
<tr>
<th>Force [cN]</th>
<th>1000</th>
<th>3500</th>
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<tbody>
<tr>
<td>80New</td>
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<td>80Def</td>
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<td>120New</td>
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<tr>
<td>120Def</td>
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</tr>
</tbody>
</table>

Annex A - Results of experiment part 3
3.2.2. Peaks and valleys

**3D-representation, XY and YZ projections**

With thread - Spectral filtering - Zero correction

Annex A - Results of experiment part 3
Peaks and valleys - Chronological sequence and average values

With thread – Spectral filtering – Zero correction

Annex A - Results of experiment part 3
Peaks and valleys - Standard deviation and coefficient of variation

With thread – Spectral filtering – Zero correction

Annex A - Results of experiment part 3
Correlation between peaks

With thread – Spectral filtering – Zero correction

Annex A – Results of experiment part 3
Peak ratios - Chronological sequence and average values

With thread – Spectral filtering – Zero correction

Annex A - Results of experiment part 3
Peak ratios - Standard deviation and coefficient of variation

With thread - Spectral filtering - Zero correction

Annex A - Results of experiment part 3
3.3. Without thread - Referenced Subtraction - Zero correction

This section shows the results obtained after processing the signals acquired without thread.
Processing was carried out using referenced subtraction and feature extraction with zero correction.

Conditions
- Experimentation Part 3
- New and damaged light ball point needles of sizes 80 and 120
- 150 thread for both needle sizes
- Dyed fabric
- Sewing speeds 1000 and 3500 spm
3.3.1. Peaks and valleys - Summary

Peaks and valleys, referenced subtraction, no thread

<table>
<thead>
<tr>
<th>Force [cN]</th>
<th>Peak1</th>
<th>Peak2</th>
<th>Valley3</th>
</tr>
</thead>
<tbody>
<tr>
<td>80New</td>
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</tbody>
</table>

Annex A - Results of experiment part 3
Peak ratios, referenced subtraction, no thread

Ratio2/1 | Ratio3/1 | Ratio3/2

80New | 80Def | 120New | 120Def | 80New | 80Def | 120New | 120Def | 80New | 80Def | 120New | 120Def

A A - Results of experiment part 3

Annex A
3.3.2. Peaks and valleys

3D-representation, XY and YZ projections

Without thread – Referenced Subtraction - Zero correction

Annex A - Results of experiment part 3
Peaks and valleys - Chronological sequence and average values

Without thread - Referenced Subtraction - Zero correction

Annex A - Results of experiment part 3
Peaks and valleys - Standard deviation and coefficient of variation

Without thread – Referenced Subtraction – Zero correction

Annex A – Results of experiment part 3
Correlation between peaks

Without thread – Referenced Subtraction – Zero correction

Annex A - Results of experiment part 3
Peak ratios - Chronological sequence and average values

Without thread – Referenced subtraction – Zero correction

Annex A - Results of experiment part 3

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Annex A - Results of experiment part 3

Without thread - Referenced Subtraction - Zero correction
This is the end of Annex A.
There is no more data. There really isn’t.
You can now go to sleep and dream with coloured bars!

(Note from the author to the author)