Standard Operating Procedure (SOP)

Streamlit MAT File Conversion & Filtering Tool

📌 Purpose of the Tool

This tool converts physiological data stored in MATLAB `.mat` files into an easy-to-use format (Excel).
It also allows **filtering** and **resampling** of the signals so they can be cleaned, averaged, and better visualized.

The tool is designed for **students and researchers with little or no programming background**.
Everything happens through the **Streamlit web interface**:

- Upload a file
- Adjust a few settings
- Download clean Excel files

⚙️ How the Tool Works

1. Upload a `.mat` file.
2. The tool automatically detects key signals:
   - **Finger Pressure**
   - **Cerebral Blood Flow (CBF)**
   - and other derived signals
3. Calibration phases in **Finapress** are automatically removed when possible.
4. Choose **filtering methods** for Finger Pressure and/or CBF to remove artifacts.
5. Resample the data:
   - **Time-based** (e.g., every 1 sec, 5 sec, 1 min)
   - **Beat-based** (e.g., 5 or 10 heartbeats)
6. Export the results into **Excel** with:
   - Timestamps
   - Elapsed time
   - Comments
   - Selected signals

🔎 Filtering Methods Explained

Filtering is **optional**. If unsure, start with defaults.

1. No Filter

- Leaves the signal exactly as recorded.
- Use this if you trust the raw data.

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2. Jump Filter

Removes sudden, unrealistic jumps in the signal caused by **sensor noise or movement**.

a. Jump Threshold (size of change)

- Defines how big a sudden change must be to count as an artifact.
- If the signal changes more than this threshold between two points, the point is flagged as invalid.
- Lower values → **more strict** (even small fluctuations removed).
- Higher values → **more tolerant** (only very large spikes removed).

b. Close Jump Window (gap between jumps)

- Looks at how close together multiple jumps are.
- If two jumps happen within this many samples, the **entire section between them is deleted**.
- Lower values → **narrow effect** (only the exact jumps removed).
- Higher values → **wider effect** (whole section between close jumps removed).

Examples (at 200 Hz sampling):

- 100 samples ≈ **0.5 sec** → removes very short noisy bursts.
- 500 samples ≈ **2.5 sec** → balanced (default).
- 1000 samples ≈ **5 sec** → aggressive, removes long sections if multiple jumps occur close together.

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3. Median Filter (Advanced for CBF)

Suppresses small **spikes (upward)** or **dips (downward)** in the CBF signal while preserving the overall shape.

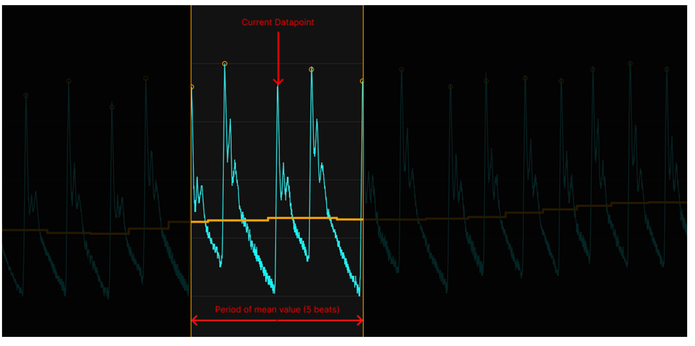
Parameters:

- **Median Window Length (smoothing strength)**
  - Defines how wide the averaging window is for smoothing.
  - Lower values → lighter smoothing (**keeps detail but leaves noise**).
  - Higher values → stronger smoothing (**removes noise but may blur sharp changes**).
- **Positive Spike Threshold (upward spikes)**
  - Defines strictness for suppressing sudden **upward spikes**.
  - Lower values → stricter (removes even small upward jumps).
  - Higher values → more tolerant (keeps detail, but large spikes may remain).
- **Negative Spike Threshold (downward dips)**
  - Defines strictness for suppressing sudden **downward dips**.
  - Lower values → stricter (removes even small dips).
  - Higher values → more tolerant (keeps detail, but some dips may remain).

📉 Resampling Options

Since raw signals are at **200 Hz** (very high frequency), you can reduce them into manageable summaries:

- **Time-based**: average signal every fixed interval (e.g., 1 sec, 10 sec, 1 min).
  Useful for long recordings.
- **Beat-based**: produces one row for **each detected beat** (separately for Finger Pressure and CBF).
  - Each channel keeps its own beat timing (Finapress and CBF beats do not align exactly).
  - For every beat, the value shown is the **mean of N beats centered around it**.
    Example:
    - With 5-beat smoothing → each data point is the average of the current beat plus the 2 beats before and the 2 beats after.
    - With 10-beat smoothing → each data point is the average of the current beat plus the 4 beats before and the 4 beats after.
  - This avoids the lag effect of using only previous beats and gives a more balanced, real-time representation.
    Useful for comparing cardiac cycles directly while accounting for natural timing differences.



⚠️ **Important**: Comments are preserved at their exact time, even if no other data is present.

📂 Exported Excel Sheets

- **Filtered(200Hz)**
  - Original signals at high resolution (200 Hz).
  - Includes applied filters and comments.
- **Resampled (Time or Beats)**
  - Cleaner, downsampled signals for easier analysis.
  - Includes timestamps, elapsed time, comments, and all selected signals.

🧑‍🔬 Notes for Non-Experts

- If you are not sure which filter to use, **start with defaults**.
- Use **No Filter** if the raw data seem clean (no obvious outliers or noise).
- Use **Jump Filter** if you see unrealistic jumps or spikes.
- Use **Median Filter** for CBF if there is high-frequency noise or small sharp spikes/dips.