📘 SmO2 Sci-Analyzer v19.2 – User Manual

1. Overview

The **SmO2 Sci-Analyzer** is a web-based tool designed to automate the mathematical modeling of Muscle Oxygen Saturation (SmO2) trends during incremental exercise tests. Unlike traditional scripts that force a specific model (e.g., Cubic), this tool intelligently selects the best-fitting mathematical pattern while adhering to the scientific principle of **Parsimony** (choosing the simplest model that adequately explains the data).

2. Getting Started

1. **Launch:** Open the html file in any modern web browser (Chrome, Edge, Firefox). No internet connection is required after loading.
2. **Upload:** Click 📂 **Upload Excel/CSV**.
    - *Supported formats:* .csv, .xlsx, .xls.
    - *Data Structure:* The file must have a Time column (seconds) and at least one SmO2 column.
3. **Select Subject:** Once loaded, use the dropdown menu "1. Subject" to choose the specific column/athlete you wish to analyze.

3. Configuration Settings

Before running the diagnostics, ensure the test protocol matches your data:

- **Load Unit:** Choose Watts (W) or Speed (km/h) for the report.
- **Start Load / Increment / Stage Dur:** Enter the protocol details (e.g., Start at 100W, increase 25W every 1 minute). *Note: If the stage duration is 1 min, thresholds will be calculated based on that step.*
- **Threshold Search Split:** (Default: 50%)
    - This slider controls the **Dual Dmax** algorithm only.
    - It defines the boundary time (percentage of the total test) where the algorithm splits the data to calculate the first vs. second Dmax threshold.
- **Outlier Z:** (Default: 2.5)
    - Controls the sensitivity of the outlier removal filter. A lower number (e.g., 2.0) removes more "noise"; selecting "OFF" keeps all raw data points.

4. Understanding the Results

A. Model Selection (Parsimony)

The app compares three models: **Linear**, **Cubic**, and **Sigmoid**.

1. It calculates the **AIC (Akaike Information Criterion)** for each.
2. It ranks the **Top 3** models.
3. **Simplicity Check:** It checks if a simpler model (e.g., Linear) is statistically "close enough" (within 3% RMSE) to a more complex winner (e.g., Sigmoid). If so, it selects the simpler model to avoid overfitting.

    - *Note:* If a **Linear** model is selected, the system will alert you that **Threshold detection is not possible** (as lines have no deflection points).

B. The Charts

- **Best Fit:** Shows the raw data (grey), outliers (red x), and the winning mathematical model (blue line).
- **Rate of Change:** The mathematical derivative of the curve.
    - TD_1: The first point where desaturation accelerates (or slope changes).
    - TD_2: The point of maximal desaturation acceleration (or leveling off).
- **Classic Algorithms:**
    - **3-Segment LTP:** Fits three distinct lines to find two breakpoints (LTP1, LTP2).
    - **Dual Dmax:** Uses the "Split" slider to calculate the maximum distance from a line connecting the start/end of each zone.

C. Bias Analysis Table

This is a critical feature for scientific validation. It compares the thresholds calculated using **1-second data** vs. **5-second averaged data**.

- **Green:** Difference is negligible.
- **Red Highlight:** Significant bias (>15W difference), suggesting that smoothing is altering the physiological interpretation.

5. Reporting

- **PDF Report:** Click 📥 **DOWNLOAD PDF REPORT**. The tool will format the charts into a clean, A4-sized document with one chart/table per page to ensure high readability.