ASC Custom Tools Data Processing Equations

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The Custom Video Creation and Data Cleaning Tool offered by ASC is not designed to make decisions on data processing but uses these calculations to make cleaned data file. The Peak Processing Equations are only used internally by the tool to place an arousal graph at the bottom of the video displaying peaks.

Data Cleaning Equations

Given two pupil dilation measurements, D_{right} and D_{left}, the dilated value D (DilatedPupil) is calculated as the average of these two measurements:

$$D = \frac{D_{\text{right}} + D_{\text{left}}}{2}$$

D is the average dilation value of the two eyes.

Peak Processing Equations

Calculation of Heart Rate Peaks Based on Z-Scores

Given the heart rate data **HR**, the mean μ_{HR} and standard deviation σ_{HR} are calculated as follows:

$$\mu_{HR} = \frac{1}{n}\sum_{i=1}^{n} HR_i, \quad \sigma_{HR} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(HR_i - \mu_{HR})^2}$$

where n is the number of heart rate measurements and HR_i is the i-th heart rate measurement.

The Z-score for each heart rate data point is computed by:

$$Z_i = \frac{HR_i - \mu_{HR}}{\sigma_{HR}}$$

Heart rate peaks are determined by the condition where the Z-score exceeds a specific threshold:

$$HR_{\text{peaks}} = \begin{cases} Z_i & \text{if } Z_i > \text{stdHeartRate} \\ 0 & \text{otherwise} \end{cases}$$

Calculation of Dilated Pupil Peaks Based on Z-Scores

Given the dilated pupil data $\mathbf{P}$, the mean μ_P and standard deviation σ_P are calculated as follows:

$$\mu_P = \frac{1}{n}\sum_{i=1}^{n} P_i, \quad \sigma_P = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(P_i - \mu_P)^2}$$

where n is the number of pupil measurements and P_i is the i-th pupil measurement.

The Z-score for each pupil data point is computed by:

$$Z_i = \frac{P_i - \mu_P}{\sigma_P}$$

Pupil peaks are determined by the condition where the Z-score exceeds a specific threshold:

$$P_{\text{peaks}} = \begin{cases} Z_i & \text{if } Z_i > \text{stdPupil} \\ 0 & \text{otherwise} \end{cases}$$

Calculation of GSR Peaks Based on Residuals from Linear Regression

Given the time series data $\mathbf{T}$ and galvanic skin response measurements $\mathbf{G}$, we fit a linear regression model predicting $\mathbf{G}$ as a function of $\mathbf{T}$:

$$\hat{\mathbf{G}} = \beta_0 + \beta_1\mathbf{T}$$

where β_0 and β_1 are coefficients estimated from the data.

The residuals from this model are calculated by subtracting the predicted $\mathbf{G}$ from the actual measurements:

$$\mathbf{R} = \mathbf{G} - \hat{\mathbf{G}}$$

The mean (μ_R) and standard deviation (σ_R) of the residuals are computed as follows:

$$\mu_R = \frac{1}{n}\sum_{i=1}^{n} R_i, \quad \sigma_R = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(R_i - \mu_R)^2}$$

where n is the number of measurements and R_i is the i-th residual.

The Z-score for each residual is computed by:

$$Z_i = \frac{R_i - \mu_R}{\sigma_R}$$

GSR peaks are determined by the condition where the residual Z-score exceeds a specific threshold:

$$GSR_{\text{peaks}} = \begin{cases} Z_i & \text{if } Z_i > \text{stdGSR} \\ 0 & \text{otherwise} \end{cases}$$