Table 1: Definitions and Formulas for Extracted Kinematic Features

Feature	**Description**	**Equation / Definition**
Grip Count	Number of grips completed during the task	N_{grips} = number of local maxima in the angle $\theta(t)$
Mean Grip Interval	Average time between grips	$\bar{T} = \frac{1}{N-1}\sum_{i=1}^{N-1}(t_{i+1}-t_i)$
SD Grip Interval	Variability in time between grips	$\sigma_T = \sqrt{\frac{1}{N-2}\sum_{i=1}^{N-1}\left((t_{i+1}-t_i)-\bar{T}\right)^2}$
Grip Frequency	Number of grips per second	$f = \frac{1}{\bar{T}}$
Opening and Closing Time	Fraction of task spent opening or closing hand	$T_{\text{open}} = \frac{\sum t_{\text{open}}}{T_{\text{total}}}, \quad T_{\text{close}} = \frac{\sum t_{\text{close}}}{T_{\text{total}}}$
Avg Opening and Closing Duration	Mean duration per opening/closing cycle	$\bar{t}_{\text{open}} = \frac{1}{N_{\text{open}}}\sum t_{\text{open}}, \quad \bar{t}_{\text{close}} = \frac{1}{N_{\text{close}}}\sum t_{\text{close}}$
Maximum Angular Amplitude	Max joint angle range (deg)	$A_{\max} = \max(\theta(t)) - \min(\theta(t))$
Total Angular Rotation	Sum of absolute angle changes	$R = \sum_{i=1}^{N-1}\lvert\theta(t_{i+1})-\theta(t_i)\rvert$
Mean Peak Angle	Average of local maxima in angle signal	$\bar{\theta}_{\text{peak}} = \frac{1}{N_p}\sum_{i=1}^{N_p}\theta(t_{p_i})$
SD of Peak Angle	Standard deviation of peak angles	$\sigma_{\text{peak}} = \sqrt{\frac{1}{N_p-1}\sum\left(\theta(t_{p_i})-\bar{\theta}_{\text{peak}}\right)^2}$
Mean Trough Angle	Average of local minima in angle signal	$\bar{\theta}_{\text{trough}} = \frac{1}{N_t}\sum_{j=1}^{N_t}\theta(t_{t_j})$
SD of Trough Angle	Standard deviation of trough angles	$\sigma_{\text{trough}} = \sqrt{\frac{1}{N_t-1}\sum\left(\theta(t_{t_j})-\bar{\theta}_{\text{trough}}\right)^2}$
Peak Slope	Slope of linear regression through peaks	$m_{\text{peak}} = \frac{\sum(t_i-\bar{t})(\theta_i-\bar{\theta})}{\sum(t_i-\bar{t})^2}$
Trough Slope	Slope of linear regression through troughs	(Same as above, applied to trough points)
Max Angular Velocity	Max first derivative of angle (deg/s)	$\omega_{\max} = \max\left\lvert\frac{d\theta}{dt}\right\rvert$
Avg Max Velocity (Closing)	Average max velocity during hand closing	$\bar{\omega}_{\text{close}} = \frac{1}{N_{\text{close}}}\sum\max\left\lvert\frac{d\theta}{dt}\right\rvert$
Avg Min Velocity (Opening)	Average min velocity during hand opening	$\bar{\omega}_{\text{open}} = \frac{1}{N_{\text{open}}}\sum\min\left(\frac{d\theta}{dt}\right)$
Velocity Energy Balance	Energy ratio: closing vs. opening	$E_{\text{balance}} = \frac{\sum_{\text{closing}}\omega(t)^2}{\sum_{\text{opening}}\omega(t)^2}$
Max Acceleration	Max second derivative of angle (deg/s^2)	$\alpha_{\max} = \max\left\lvert\frac{d^2\theta}{dt^2}\right\rvert$
Avg Max Accel (Closing)	Mean max acceleration during closing	$\bar{\alpha}_{\text{close}} = \frac{1}{N_{\text{close}}}\sum\max\left\lvert\frac{d^2\theta}{dt^2}\right\rvert$
Avg Min Accel (Closing)	Mean min acceleration during closing	$\underline{\alpha}_{\text{close}} = \frac{1}{N_{\text{close}}}\sum\min\left(\frac{d^2\theta}{dt^2}\right)$
Avg Max Accel (Opening)	Mean max acceleration during opening	$\bar{\alpha}_{\text{open}} = \frac{1}{N_{\text{open}}}\sum\max\left\lvert\frac{d^2\theta}{dt^2}\right\rvert$
Avg Min Accel (Opening)	Mean min acceleration during opening	$\underline{\alpha}_{\text{open}} = \frac{1}{N_{\text{open}}}\sum\min\left(\frac{d^2\theta}{dt^2}\right)$
Max Jerk	Max third derivative of angle (deg/s^3)	$j_{\max} = \max\left\lvert\frac{d^3\theta}{dt^3}\right\rvert$
Avg Max Jerk (Closing)	Mean of max jerk in closing phases	$\bar{j}_{\text{close}} = \frac{1}{N_{\text{close}}}\sum\max\left\lvert\frac{d^3\theta}{dt^3}\right\rvert$
Avg Min Jerk (Closing)	Mean of min jerk in closing phases	$\underline{j}_{\text{close}} = \frac{1}{N_{\text{close}}}\sum\min\left(\frac{d^3\theta}{dt^3}\right)$
Avg Max Jerk (Opening)	Mean of max jerk in opening phases	$\bar{j}_{\text{open}} = \frac{1}{N_{\text{open}}}\sum\max\left\lvert\frac{d^3\theta}{dt^3}\right\rvert$
Avg Min Jerk (Opening)	Mean of min jerk in opening phases	$\underline{j}_{\text{open}} = \frac{1}{N_{\text{open}}}\sum\min\left(\frac{d^3\theta}{dt^3}\right)$