

**Titre:** Central and peripheral shoulder fatigue pre-screening using the sigma-lognormal model: a proof of concept  
Title:

**Auteurs:** Anaïs Laurent, Réjean Plamondon, & Mickael Begon  
Authors:

**Date:** 2020

**Type:** Article de revue / Article

**Référence:** Laurent, A., Plamondon, R., & Begon, M. (2020). Central and peripheral shoulder fatigue pre-screening using the sigma-lognormal model: a proof of concept. Frontiers in Human Neuroscience, 14, 171 (16 pages).  
Citation: <https://doi.org/10.3389/fnhum.2020.00171>

## Document en libre accès dans PolyPublie

Open Access document in PolyPublie

**URL de PolyPublie:** <https://publications.polymtl.ca/45957/>  
PolyPublie URL:

**Version:** Matériel supplémentaire / Supplementary material  
Révisé par les pairs / Refereed

**Conditions d'utilisation:** CC BY  
Terms of Use:

## Document publié chez l'éditeur officiel

Document issued by the official publisher

**Titre de la revue:** Frontiers in Human Neuroscience (vol. 14)  
Journal Title:

**Maison d'édition:** Frontiers Media S.A.  
Publisher:

**URL officiel:** <https://doi.org/10.3389/fnhum.2020.00171>  
Official URL:

**Mention légale:** Copyright © 2020 Laurent, Plamondon and Begon. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.  
Legal notice:

## *Supplementary Material*

**Table 1 | Resume of the parameters extracted and their signification**

<b>Input level: central system</b>	
$t_0$	It is the time that takes the brain to perceive the stimulus and emit the command to the musculoskeletal system. It refers to the moment when a population of neurons sends a motor command, it occurs after the audible stimulus is perceived and the motor command prepared.
$\Delta(t_0)$	It reflects the rhythmicity of an input command. It represents the time elapsed between two successive $t_0$ and is used in the oscillations only.
$D$	It corresponds to the distance covered by the resulting lognormal.
$\theta_s$	It is the starting angle of the lognormal.
$\theta_e$	It is the ending angle of the lognormal.
<b>Timing properties of the neuromuscular system: peripheral system</b>	
$\mu$	Also known as the logtime delay, it represents the time taken to reach half of the distance movement on a logarithmic scale. It corresponds to the rapidity of a reaction to a command by a system.
$\sigma$	Also known as the logresponse time, it represents the time taken from the neuromuscular system to respond to a command on a logarithmic scale. It is also linked to the movement duration and is a measure of the asymmetry of the lognormal.
<b>Global state of the neuromotor system</b>	
<b>Nblog</b>	It is the number of lognormals required to reconstruct the velocity profile of the movement.
<b>SNR</b>	It is the measure of the quality of the movement reconstruction.
<b>SNR/Nblog</b>	It is a performance criterion and represents the motor control fluency of a gesture. The lognormality principle predicts that the ideal movement converges toward a lognormal profile. When the SNR/Nblog is higher, the movement is more similar to the ideal one, as postulated by the lognormal behavior.

<b>Motor program execution</b> ( $\Delta(t_0)$ is used instead of $t_0$ for the calculus in the oscillations)		
<b>Mode</b>	It is the time at which the maximum value of the lognormal impulse response is reached.	$M = t_0 + e^{\mu - \sigma^2}$
<b>Median</b>	It corresponds to the time at which the half value of the integral under the lognormal curve (50% of the covered distance) is reached.	$m = t_0 + e^{\mu}$
<b>Time delay</b>	It represents the rapidity of a neuromuscular system to respond to a command.	$\bar{t} = t_0 + e^{\mu + 0.5\sigma^2}$
<b>Response time</b>	It is a measure of the spread of the impulse response.	$s = (\bar{t} - t_0) \sqrt{(e^{\sigma^2} - 1)}$
<b>Asymmetry</b>	It characterizes the shape of the lognormal.	$A_c = 1 - e^{-\sigma^2}$
<b>Other parameters</b>		
<b>Reaction time</b>	It is the time needed to start the movement after a stimulus. In the present study, it was computed as the time required to reach 10% of the maximal velocity during the test	
<b>Command propagation</b>	It is the duration of the command propagation	$CP = RT - t_0$