Graphisme, animation et nouveaux médias

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Graphics, Animation and New Media

A Machine Learning Approach to Automate Facial Expressions from Physical Activity

Tarik Boukhalfi, Christan Desrosiers, Eric Paquette

École de technologie supérieure

ÉTS

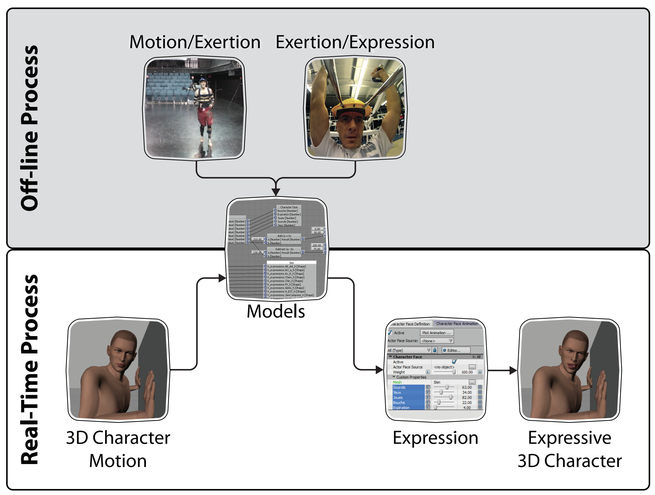
Le génie pour l'industrie

Overidew: *The purpose of this research is to highlight the link between physical activity and facial expression. It proposes a data-driven approach to realistically simulate the facial expression related to physical activity while leaving creative control.*

Data Acquisition

Motion capture was used to gather information relating biological, mechanical and facial expressions data.

System Overview



Two capture sessions were conducted. The first one was aimed to link the 3D character's motion to the metabolic parameters and the second one to link 3D charcter's motion and metabolic parameters to the facial animation.

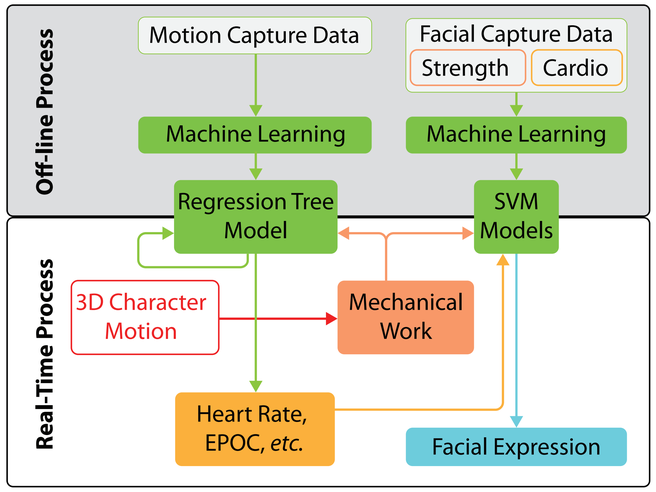
Summary of the two capture sessions

Capture session	Full body	Facial
Number of participants	15	17
Exercice duration	7 to 13 min	19 to 43 min
Age	20 to 46	20 to 43
Age Average	30.4	28.1
Training Level	0 to 7.5	0 to 7.5

Facial Expressions Synthesis

This information was then used to train regression trees and Support Vector Machine models that can predict facial expressions from inputs such as the 3D character motion, the weights lifted, etc.

Models Overview



In a fist step, the heart rate is predicted using a regression tree model and other metabolic parameters are calculated.

$$t_{root} = 7.13 + 0.42 \times \text{training level}$$

$$\Delta(\text{nhr}) = \begin{cases} c_{\text{inc}} \times (w - t_{root}) \times (1 - \text{nhr})^2 & t_{root} < w \\ c_{\text{dec}} \times (w - t_{root}) \times \text{nhr}^2 & w \leq t_{root} \end{cases}$$

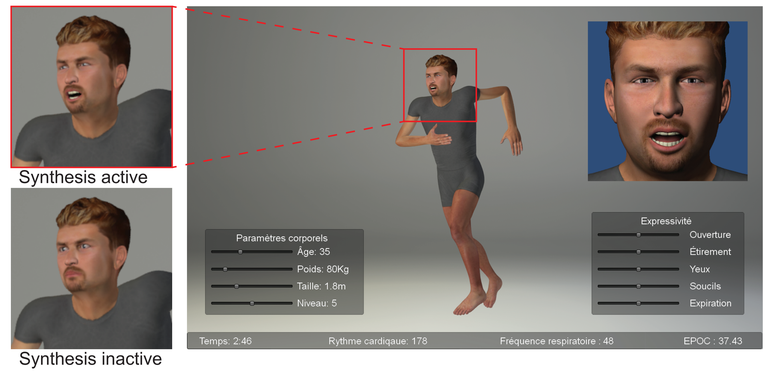
$$c_{\text{inc}} = 0.0056 - 0.00043 \times \text{training level}$$

$$c_{\text{dec}} = 0.0009 + 0.00025 \times \text{training level}$$

Then, facial animation is estimated using Support Vector Machine models that predict the blend shape weights.

Results

Real-time results



From the 3D character's motion, the facial expressions related to effort and fatigue are synthesized

Results for a 5 minutes run

Diffferent parameters can be changed to achieve different results.

Different expressiveness vectors

The resulting expressions can be softened or exaggerated for greater creative control.