Modulation de frottement par lubrification active

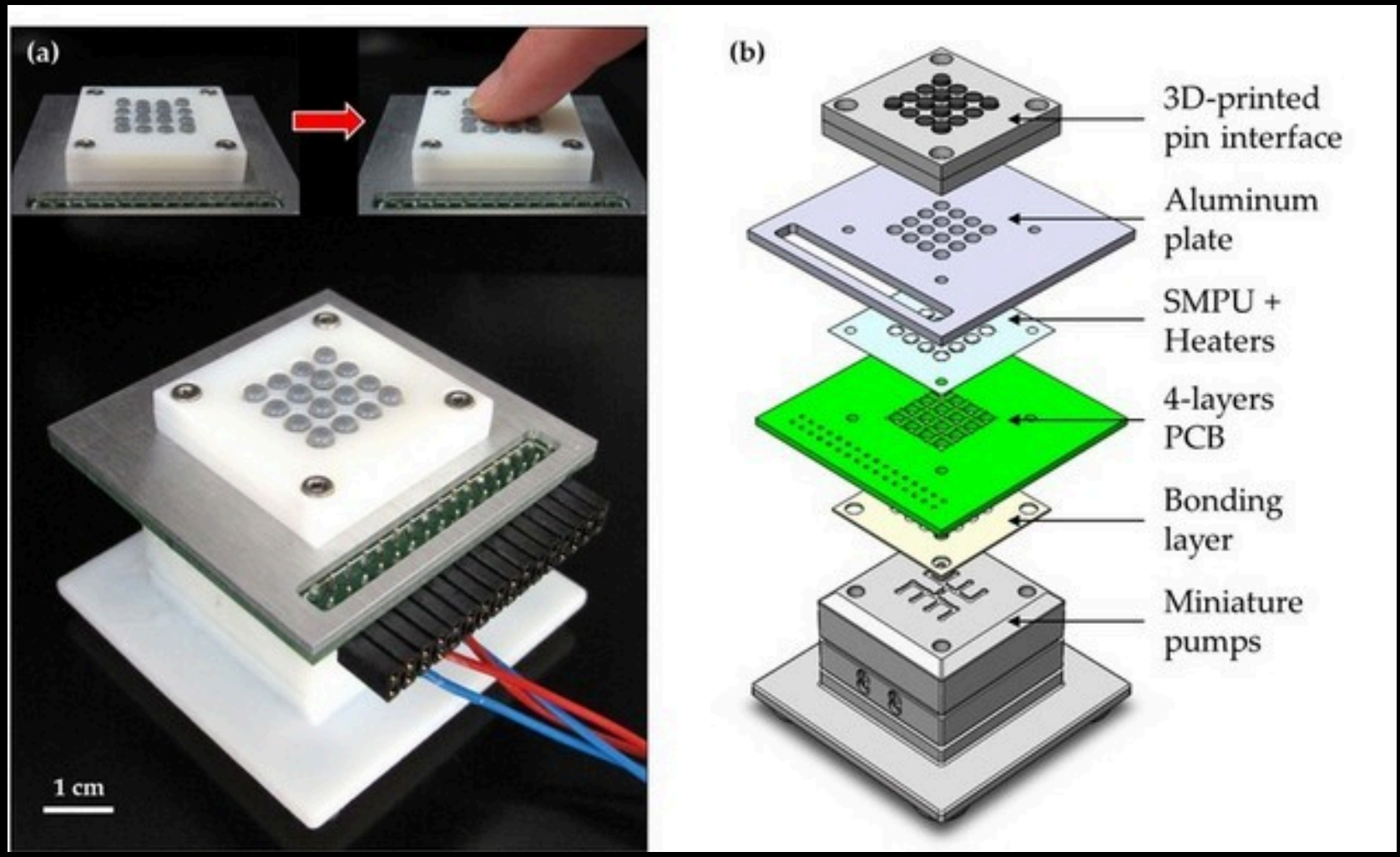
Frédéric Giraud, Betty Semail, Christophe Giraud-Audine, Angelica Torres

Professeur des Université à l'Université de Lille
Laboratoire L2EP
Membre du projet « interfaces tactiles et gestuelles » de l'IRCICA

1/ Pourquoi
2/ Comment (Modèles)
3/ Mise en oeuvre

1/ Pourquoi
2/ Comment (Modèles)
3/ Mise en oeuvre

Stimulateurs tactiles : reproduire les surfaces



N. Besse, S. Rosset, J. J. Zárate, E. Ferrari, L. Brayda and H. Shea, "Understanding Graphics on a Scalable Latching Assistive Haptic Display Using a Shape Memory Polymer Membrane," in IEEE Transactions on Haptics, vol. 11, no. 1, pp. 30-38, 1 Jan.-March 2018, doi: 10.1109/TOH.2017.2767049.

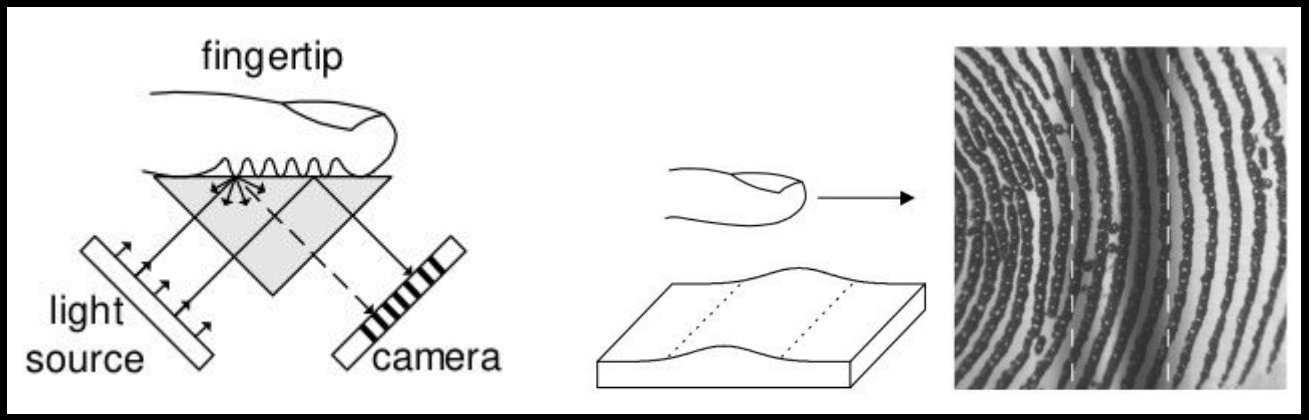
Reproduire l’effet des surfaces sur la peau

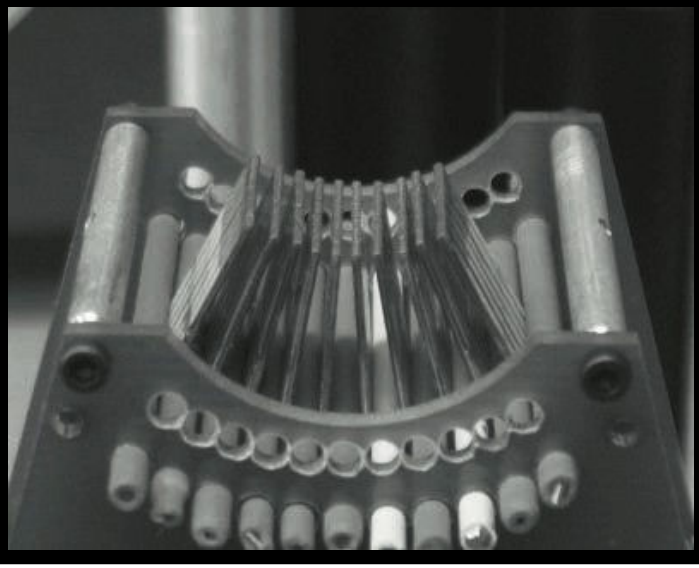
Letter | Published: 26 July 2001

Force can overcome object geometry in the perception of shape through active touch

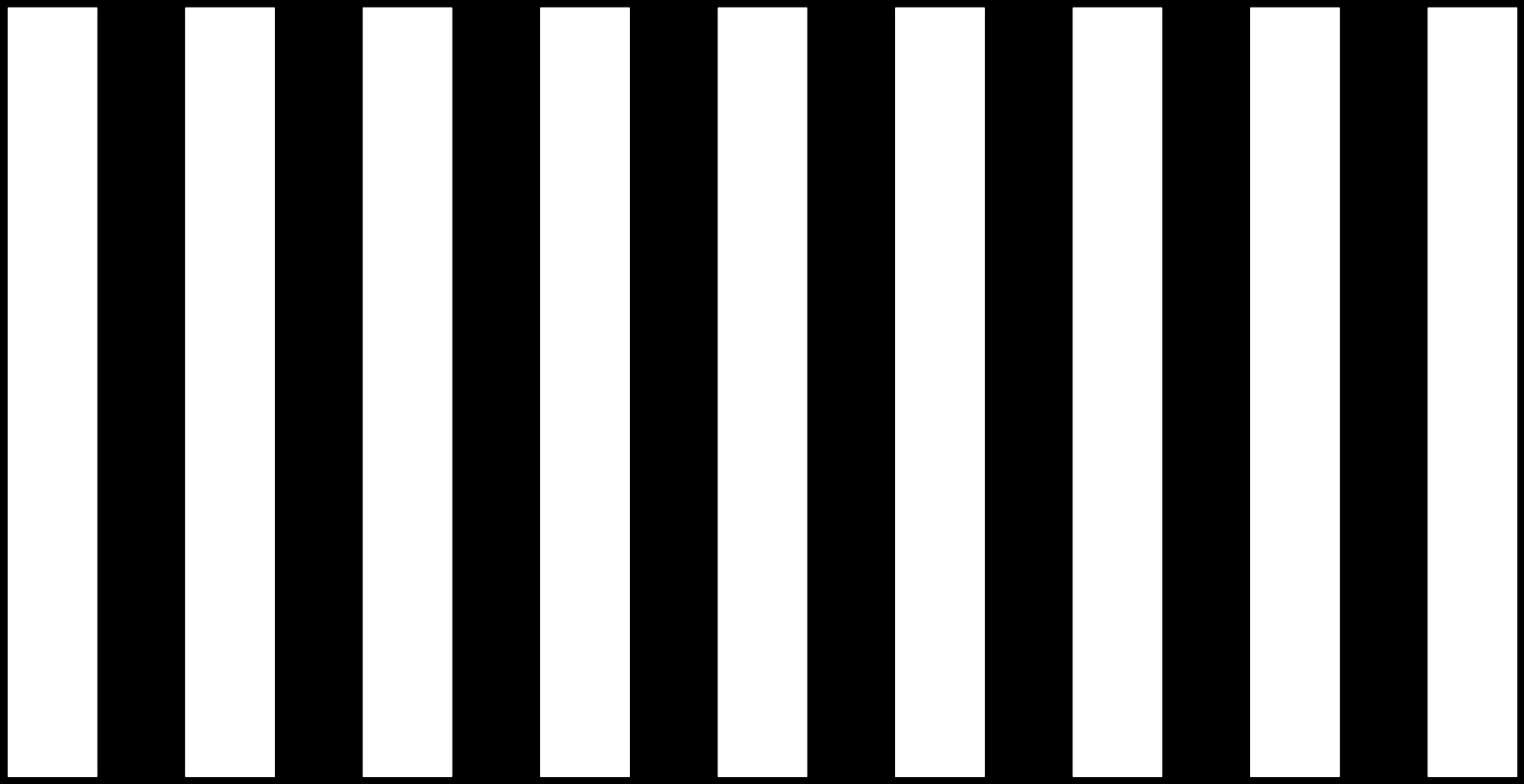
Gabriel Robles-De-La-Torre & Vincent Hayward

Nature **412**, 445–448 (2001) | Cite this article





Illusion tactile



Illusion tactile

Conferences > 2008 Symposium on Haptic Inte...

Discrimination of Virtual Square Gratings by Dynamic Touch on Friction Based Tactile Displays

Publisher: IEEE

Cite This

PDF

Melisande Biet ; Gery Casiez ; Frederic Giraud ; Betty Lemaire-Semail All Authors

1/ Pourquoi
2/ Comment (Modèles)
3/ Mise en oeuvre

Lubrification électro-active

Lubrification active :

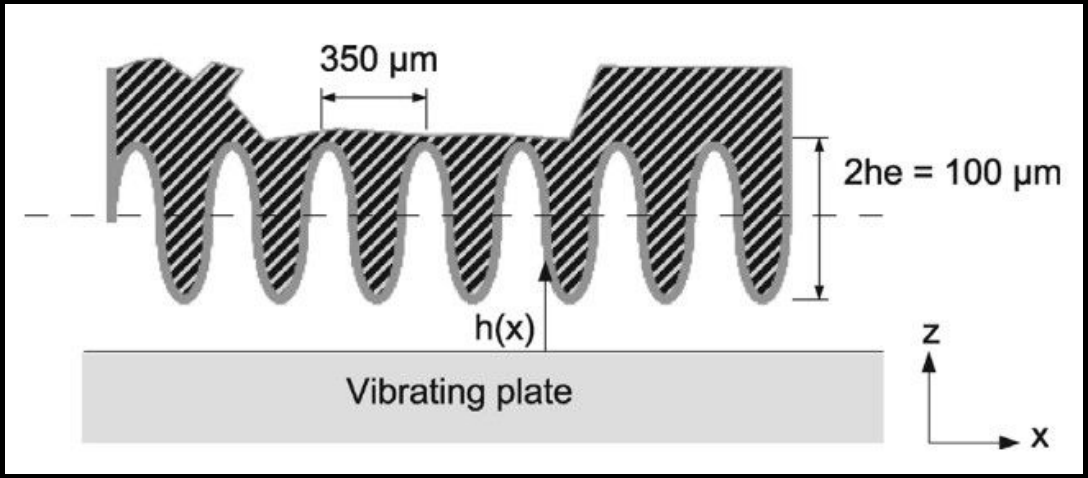
- 30kHz
- 1µm p-p

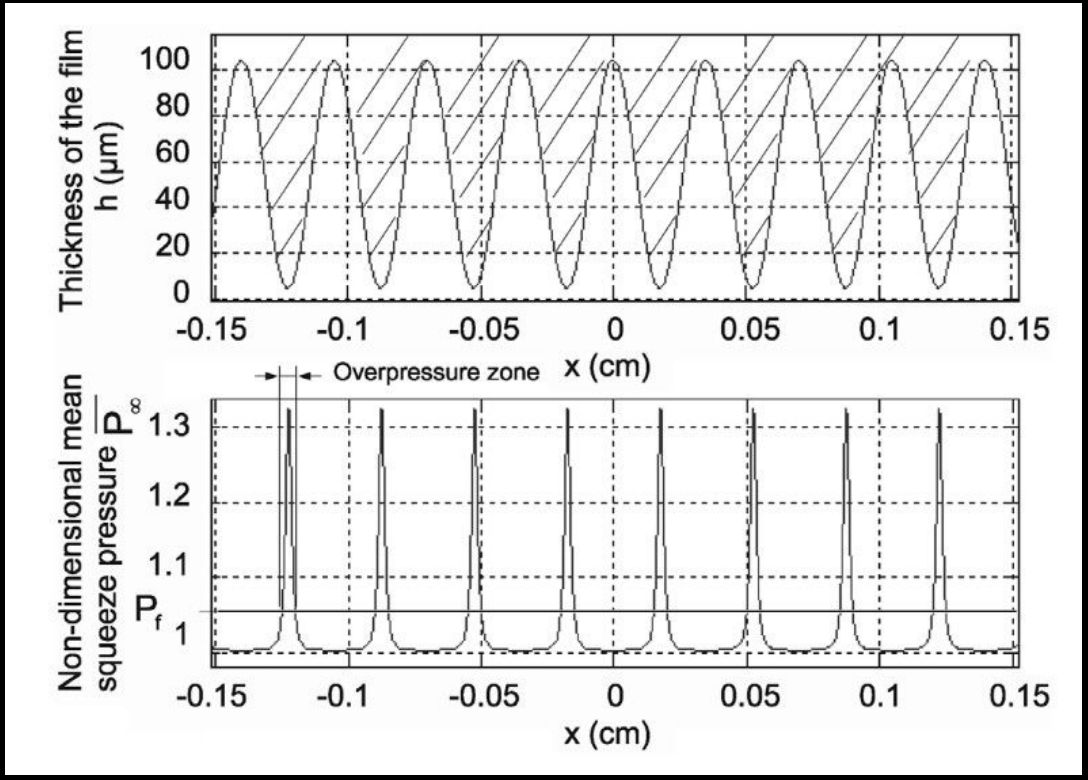
Deux modèles pour expliquer la réduction de frottement

- Squeeze film
- Contact intermittent

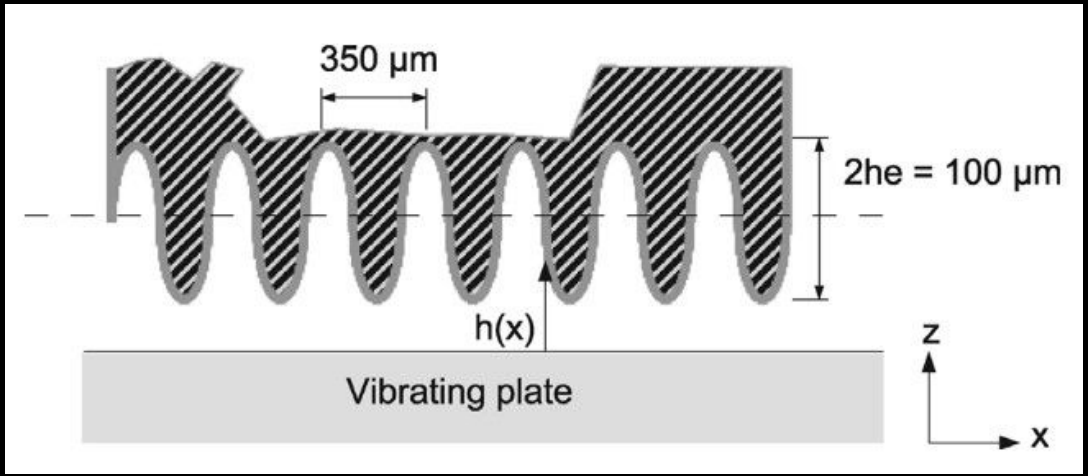
Modèle de squeeze-film

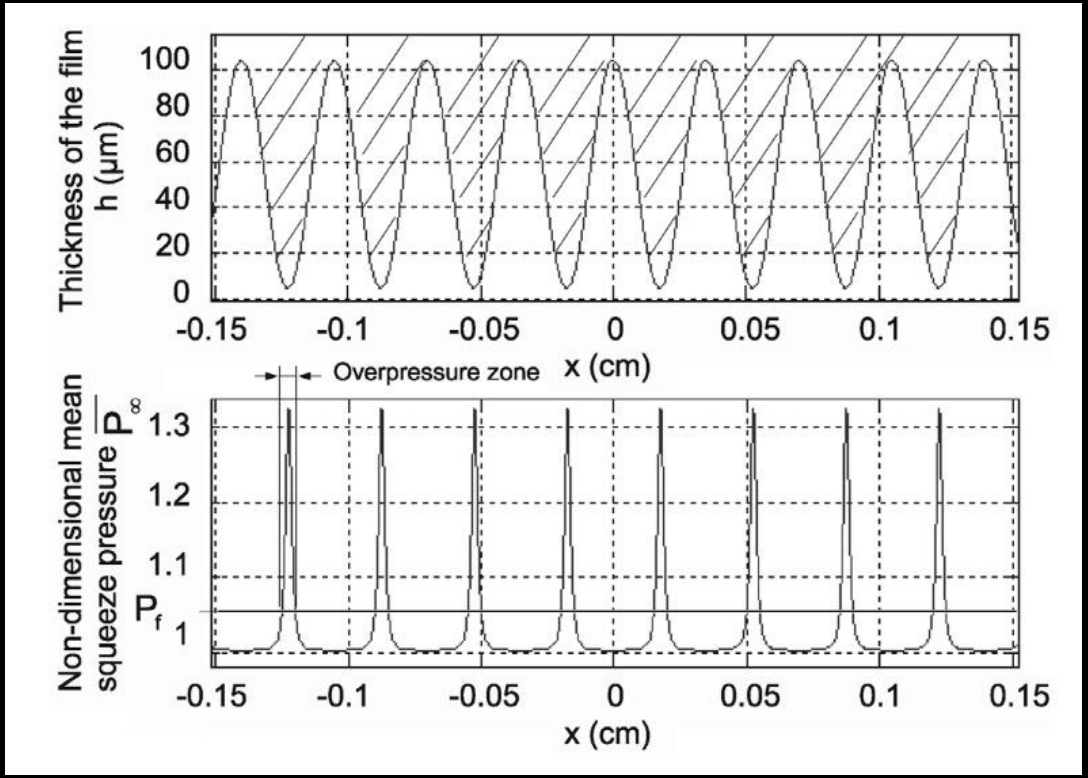
Modèle de squeeze-film





Modèle de squeeze-film





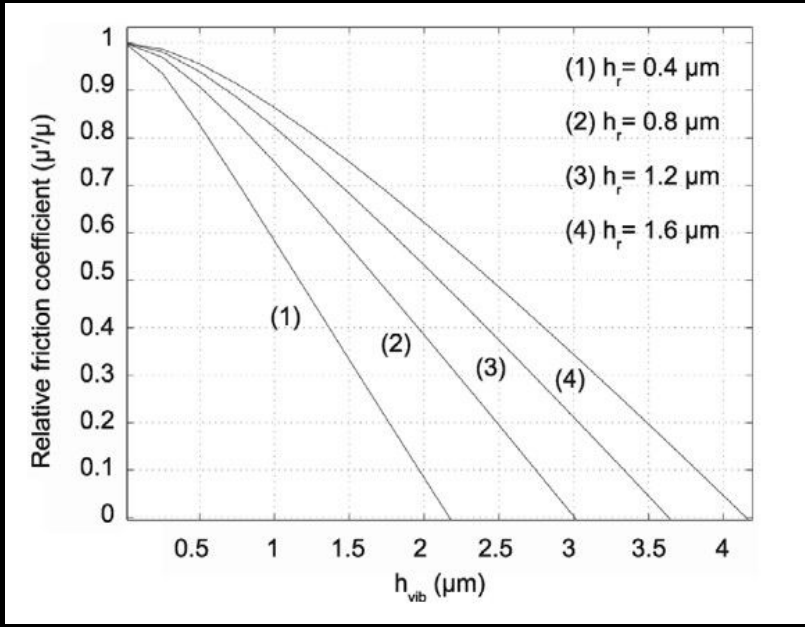
$$\sigma = \frac{12\eta\omega_0 l_0}{p_0(h_0 + h_e)^2}$$

Si

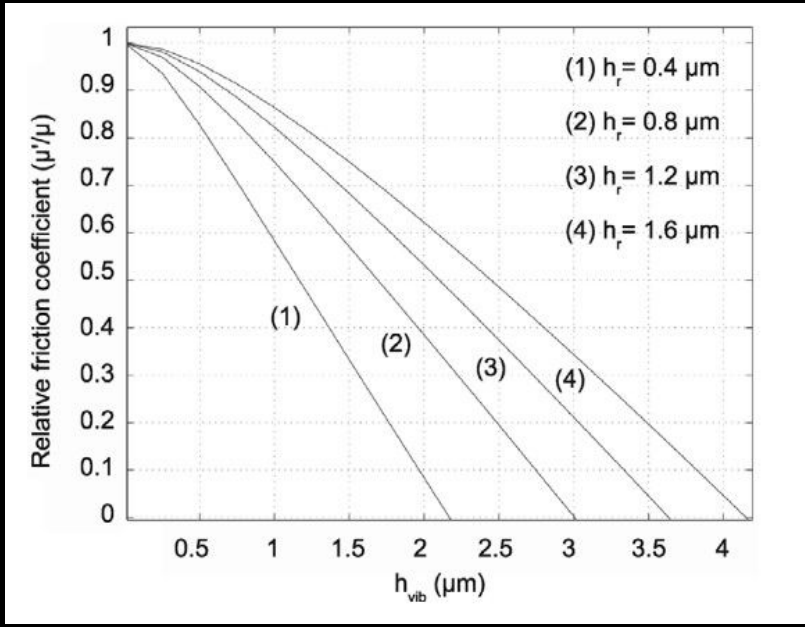
$$\sigma > 10$$

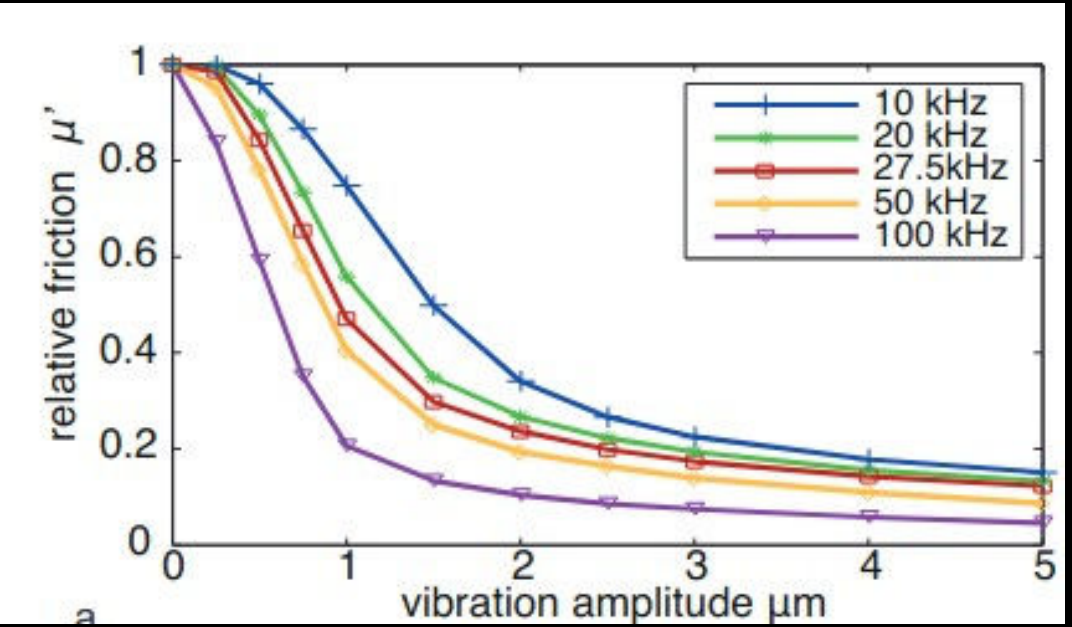
$$\overline{P_\infty} = p_0 \frac{(1+\delta\cos(kX))\sqrt{(1+\delta\cos(\frac{k}{2}))^2 + \frac{3}{2}\epsilon^2}}{(1+\delta\cos(\frac{k}{2}))\sqrt{(1+\delta\cos(kX))^2 - \epsilon^2}}$$

Modèle de squeeze-film



Modèle de squeeze-film



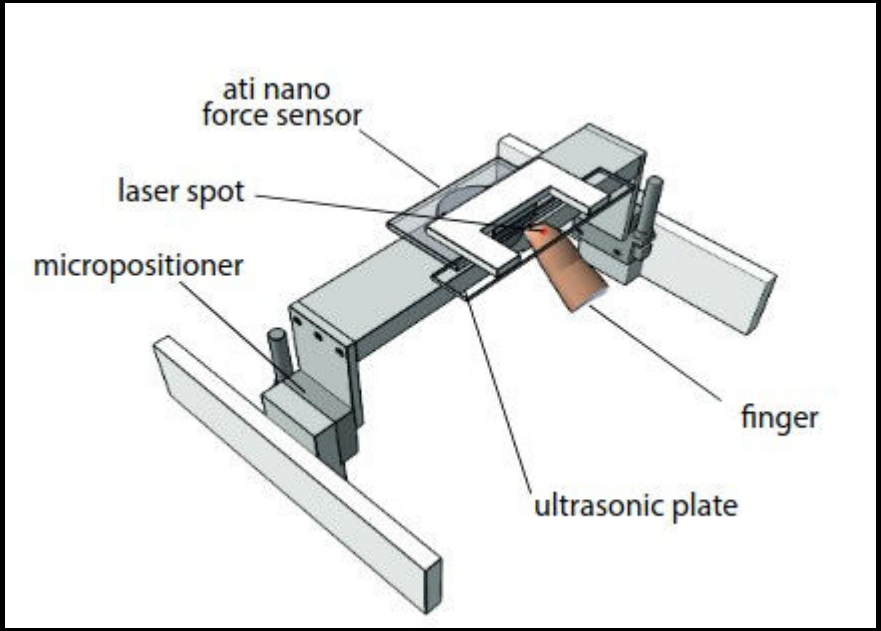


$$\overline{P_\infty} = p_0 \frac{(1+\delta\cos(kX))\sqrt{(1+\delta\cos(\frac{k}{2}))^2+\frac{3}{2}\epsilon^2}}{(1+\delta\cos(\frac{k}{2}))\sqrt{(1+\delta\cos(kX))^2-\epsilon^2}}$$

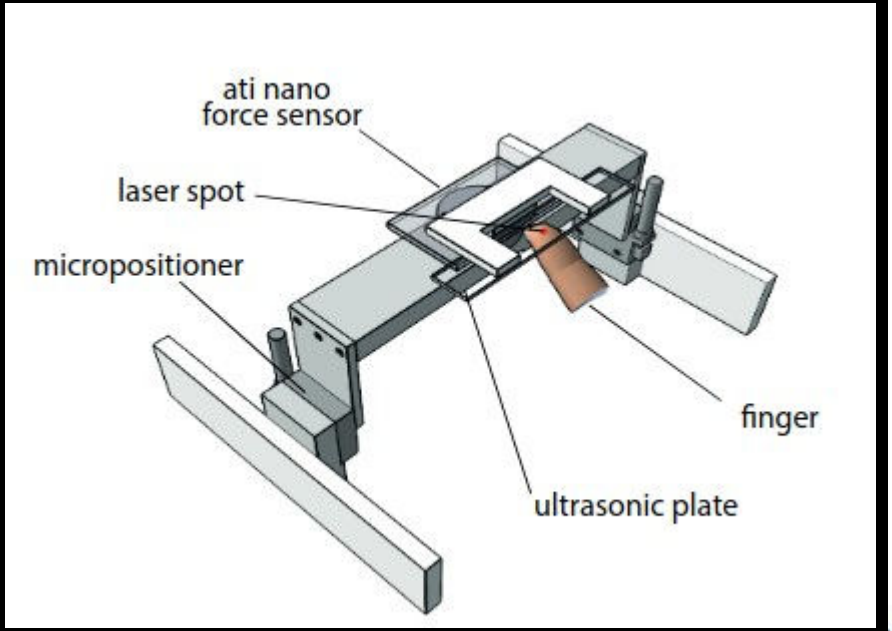
Ce modèle explique la réduction de frottement, mais elle n'explique pas l'effet de la fréquence vibratoire

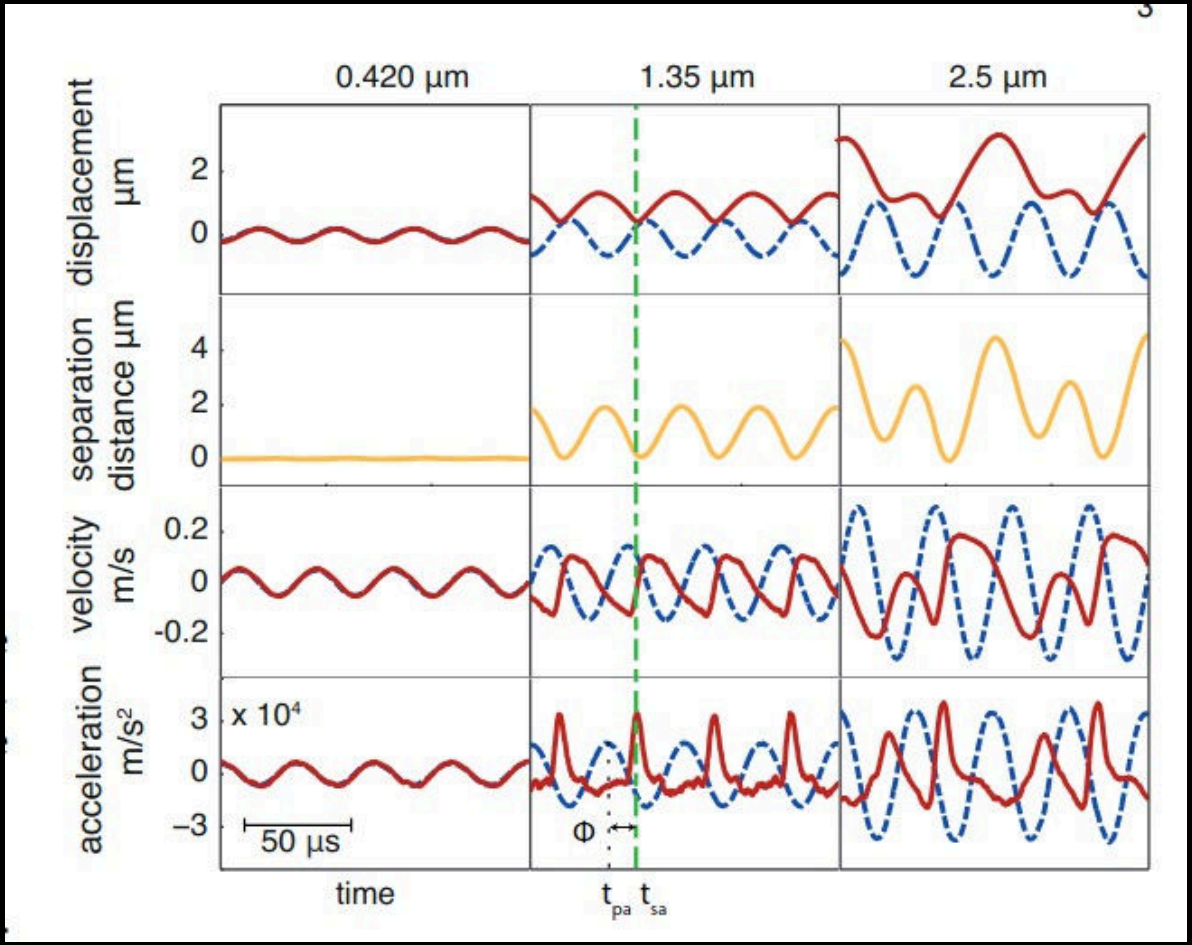
Modèle de contact intermittent

Modèle de contact intermittent



Modèle de contact intermittent

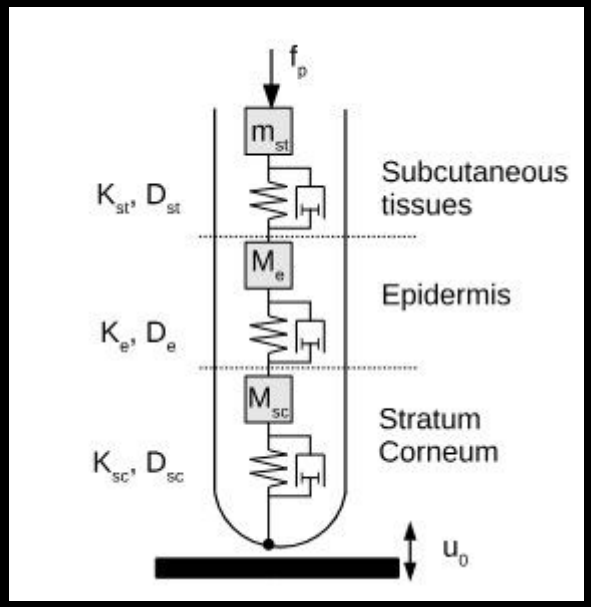


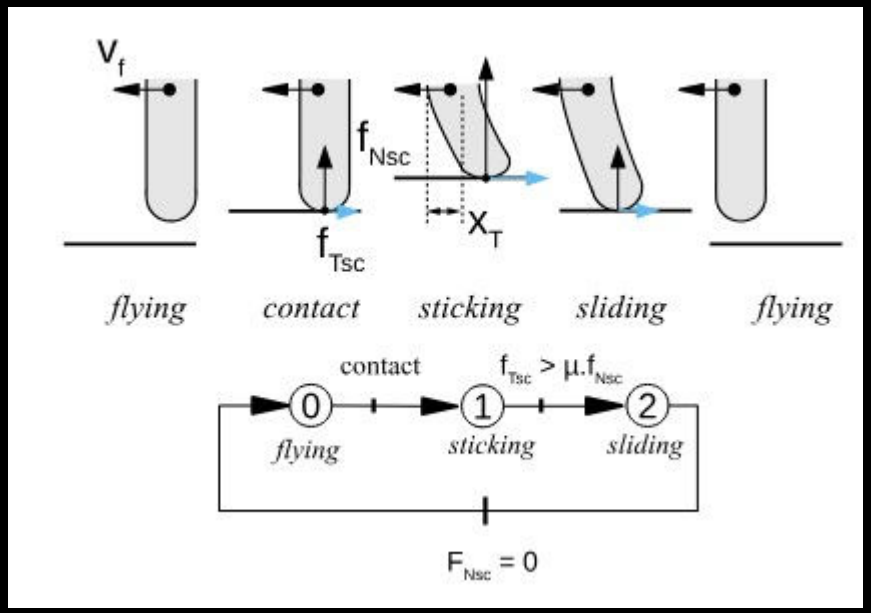


Sous l'effet des vibration, le doigt n'est pas en contact permanent

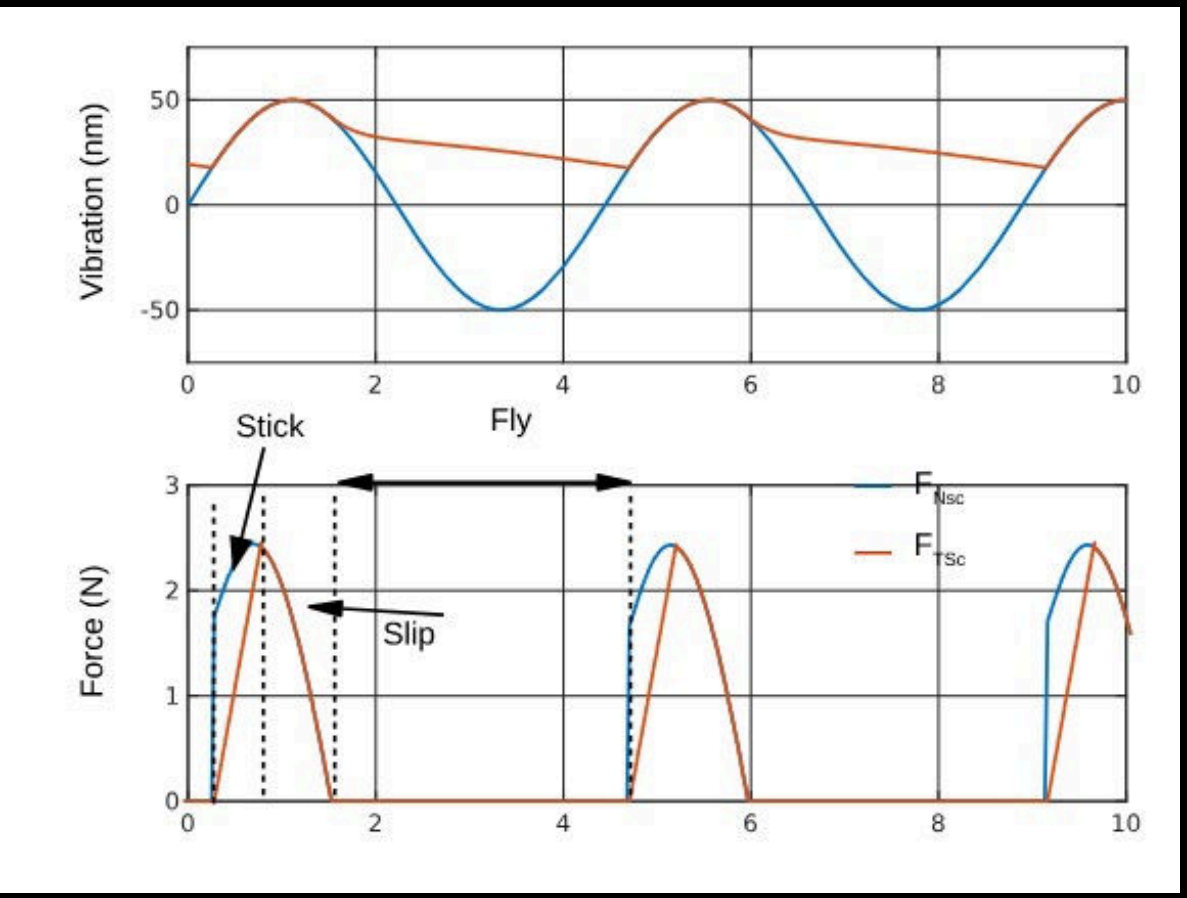
Modèle de contact intermittent

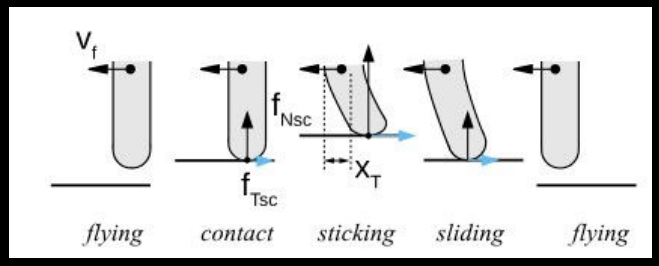
Le doigt est élastique



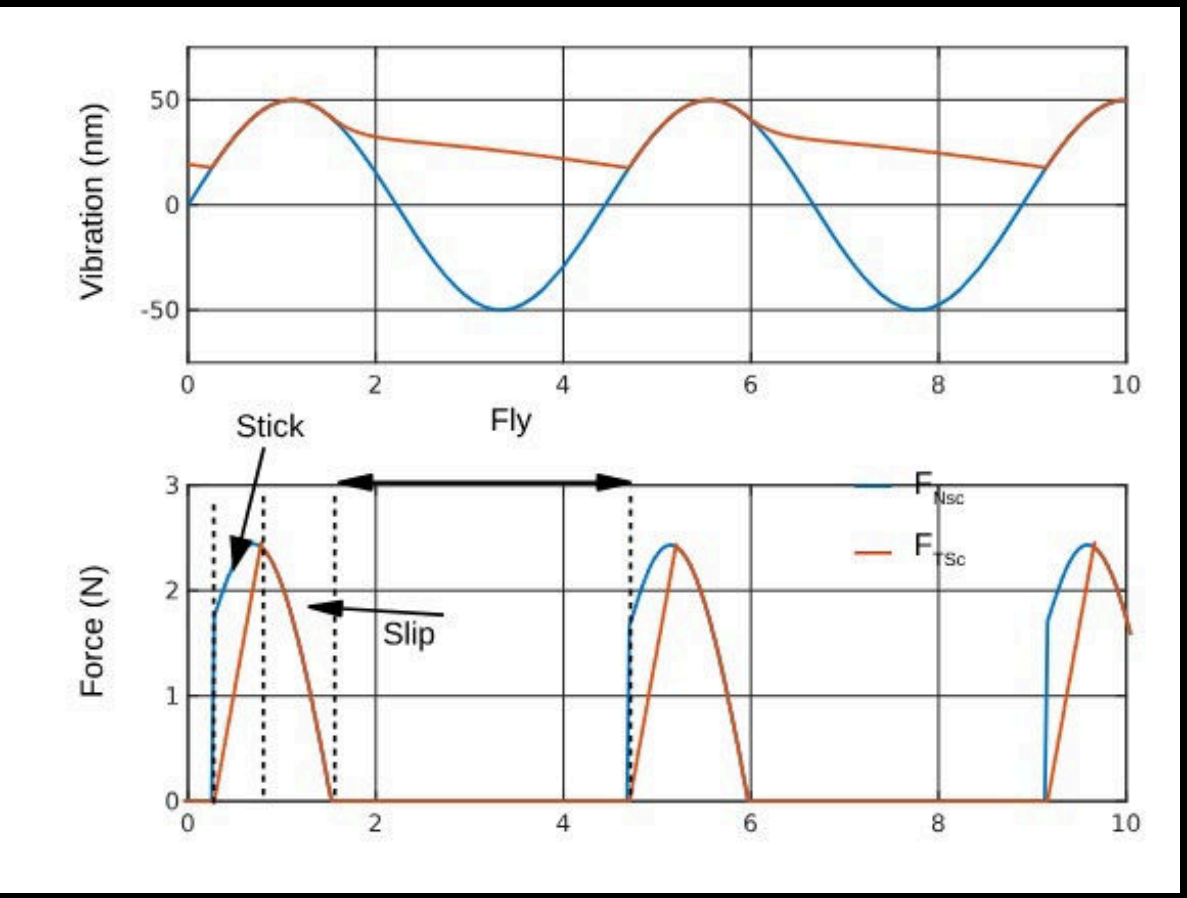


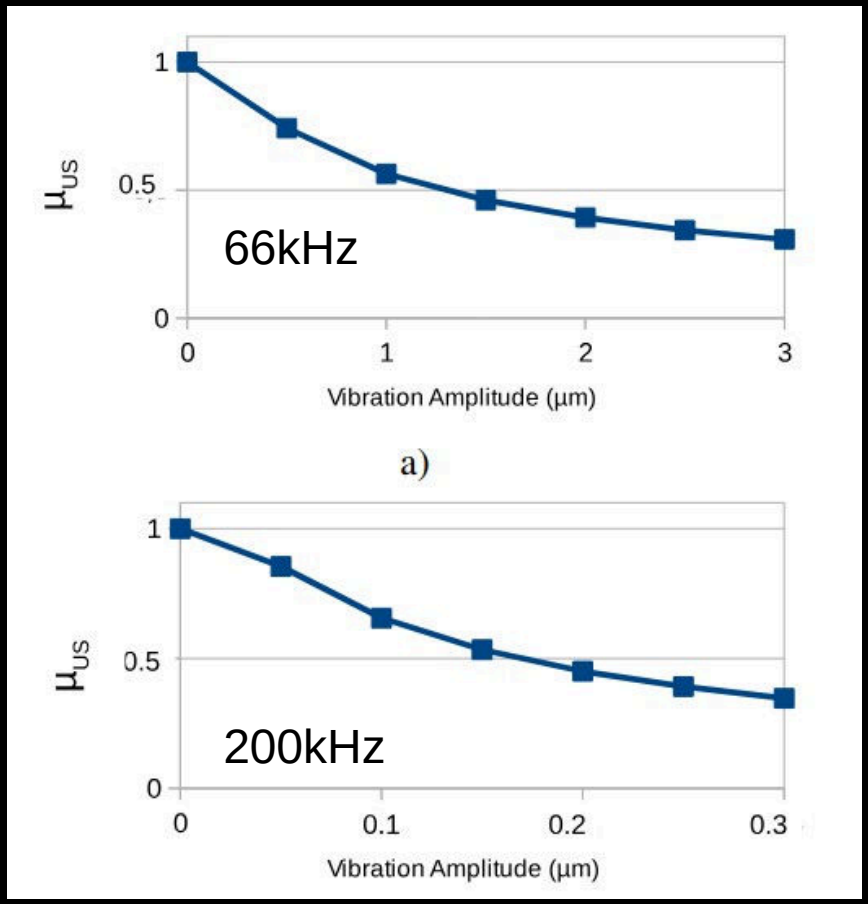
Modèle de contact intermittent

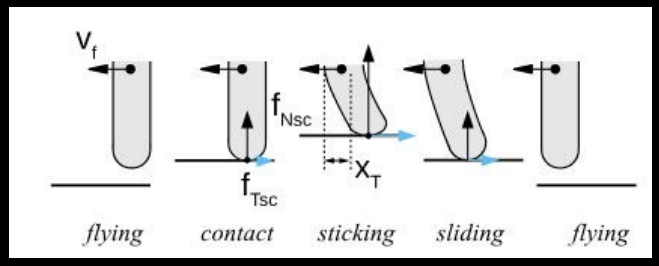




Modèle de contact intermittent



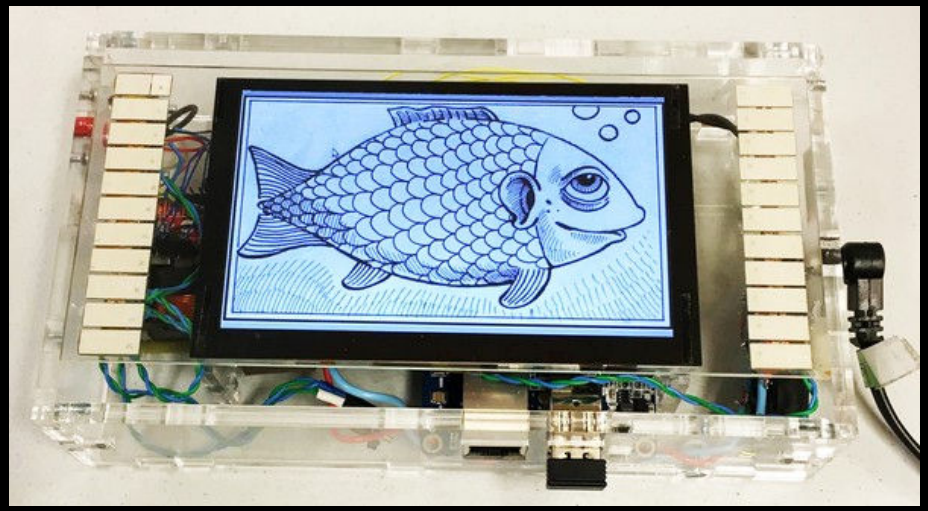




- La réduction de frottement est obtenu pour des vibrations de fréquence supérieure à 30kHz
- L’amplitude vibratoire requise est de l’ordre de 1µm
- La vibration n’est pas perçue

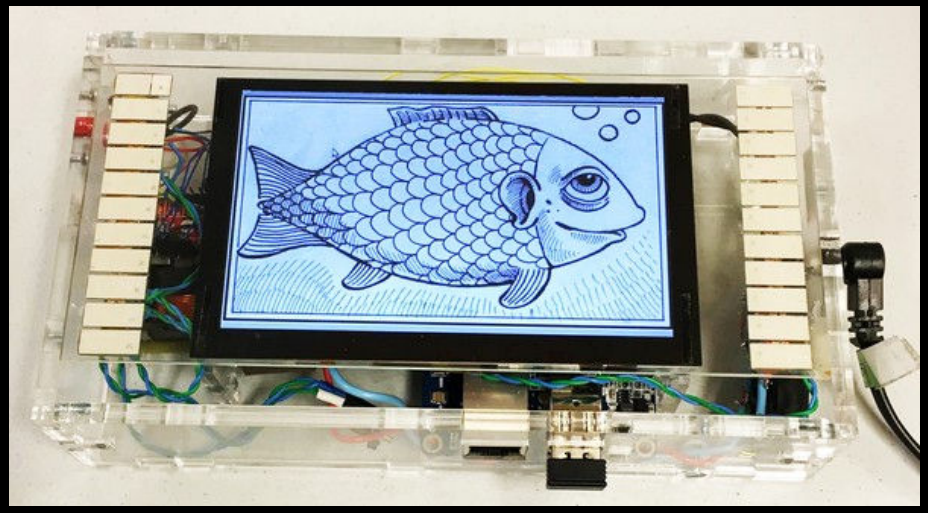
Mise en oeuvre

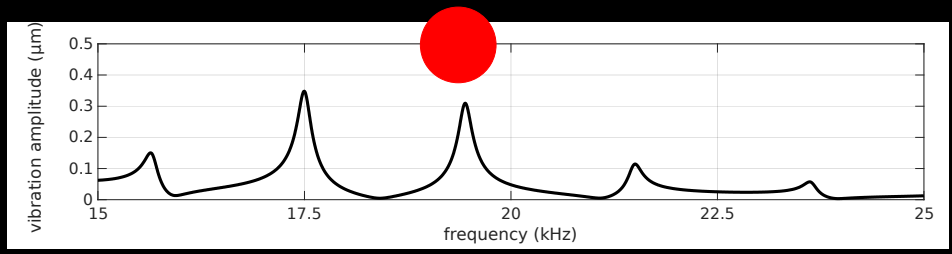
- Excitation d’un mode de vibration par des céramiques piézoélectriques

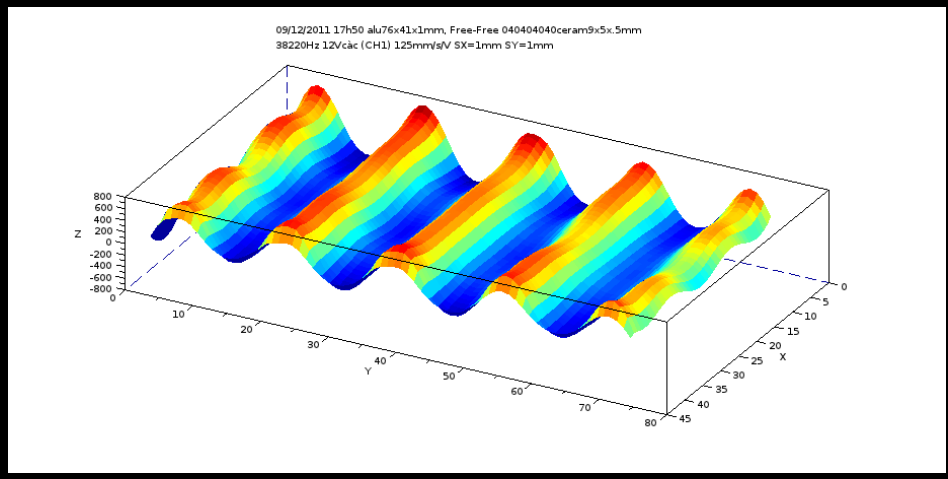


Mise en oeuvre

- Excitation d’un mode de vibration par des céramiques piézoélectriques

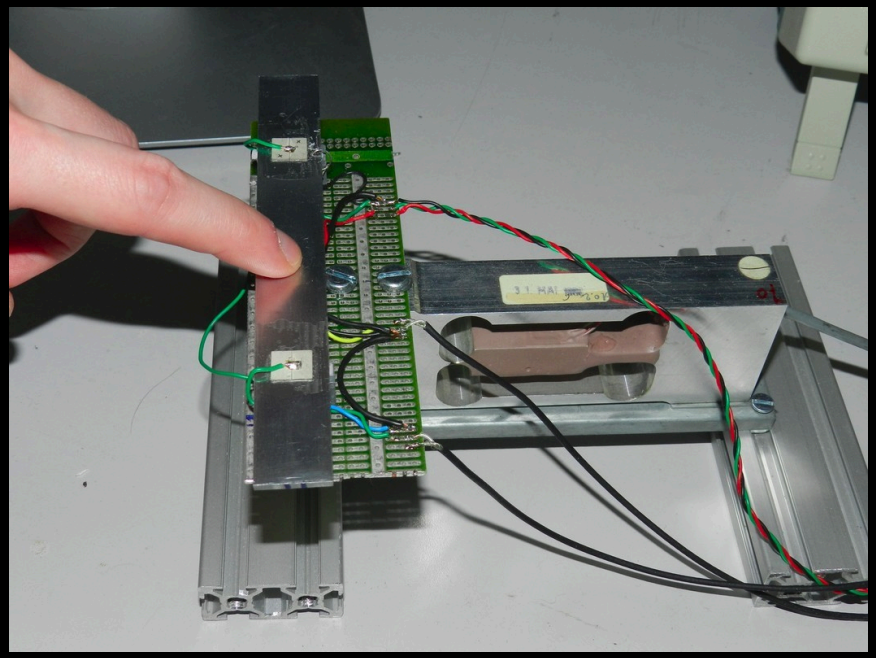






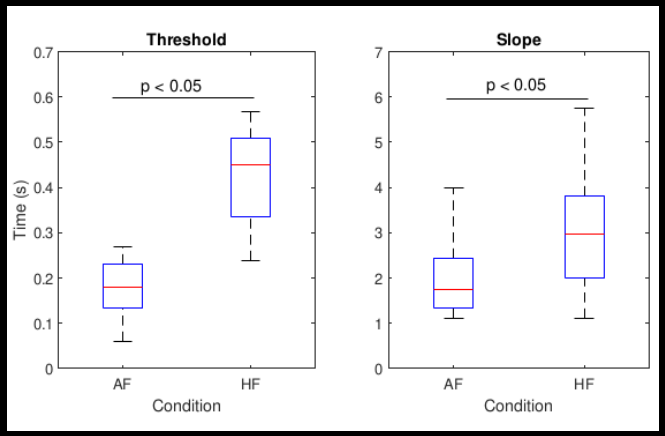
Il faut que la demi-longueur d’onde ~8mm

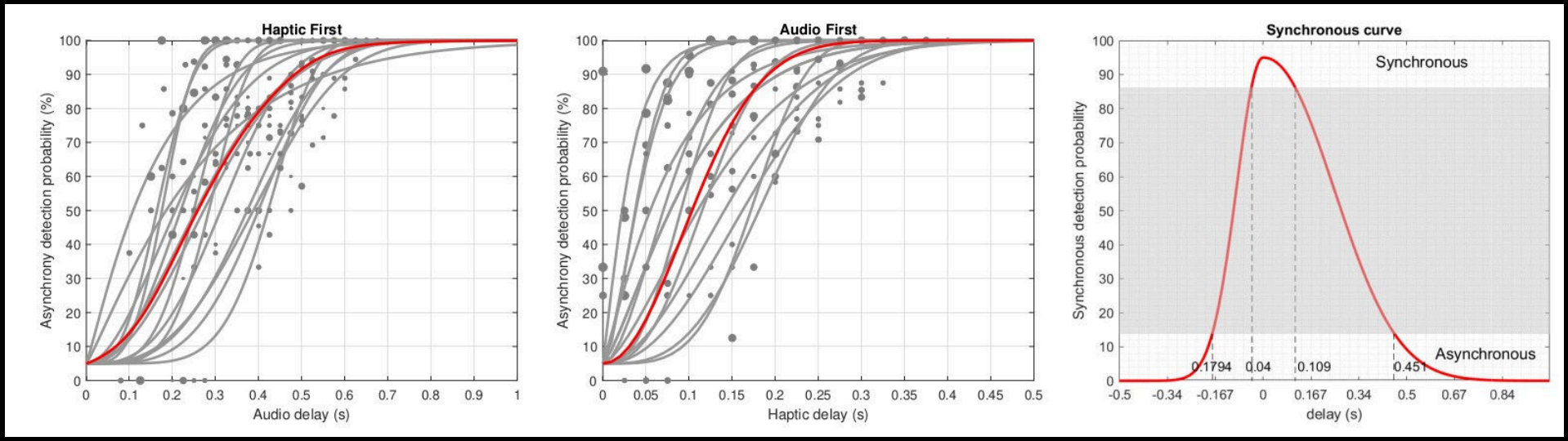
Ultrasonically induced lateral forces



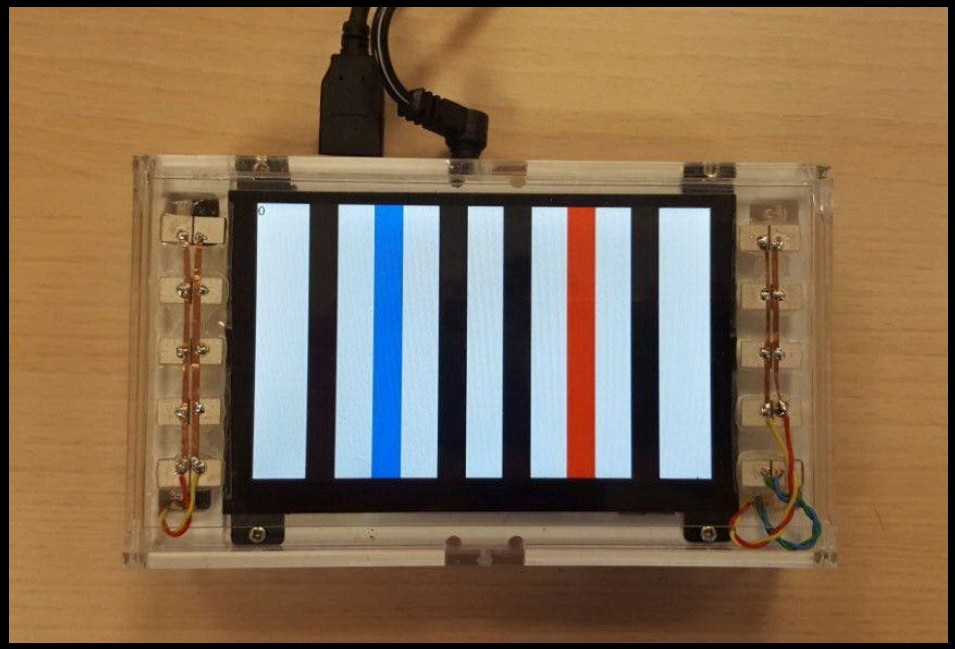
Control of an ultrasonic haptic interface for button simulationP Garcia, F Giraud, B Lemaire-Semail, M Rupin, A KaciSensors and Actuators A: Physical 342, 113624

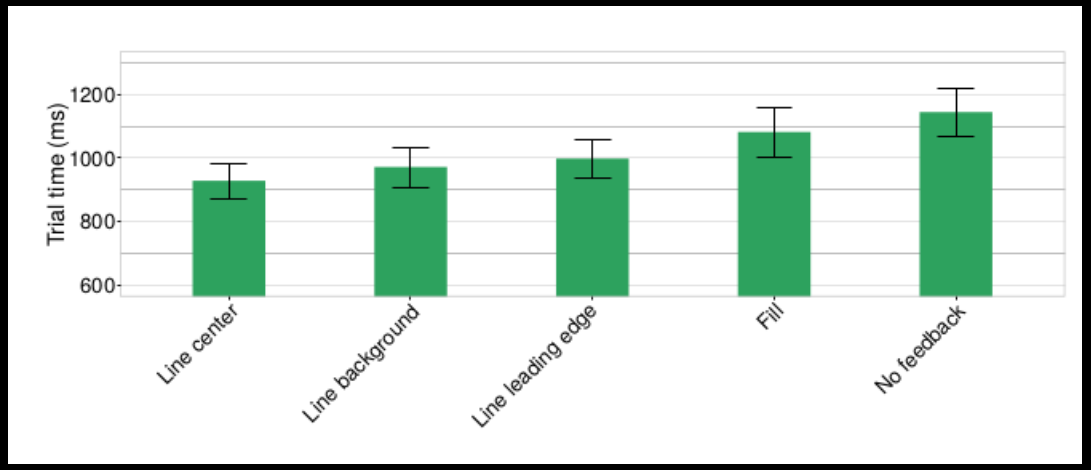
Measuring perfomances → Psychophysics





Applications



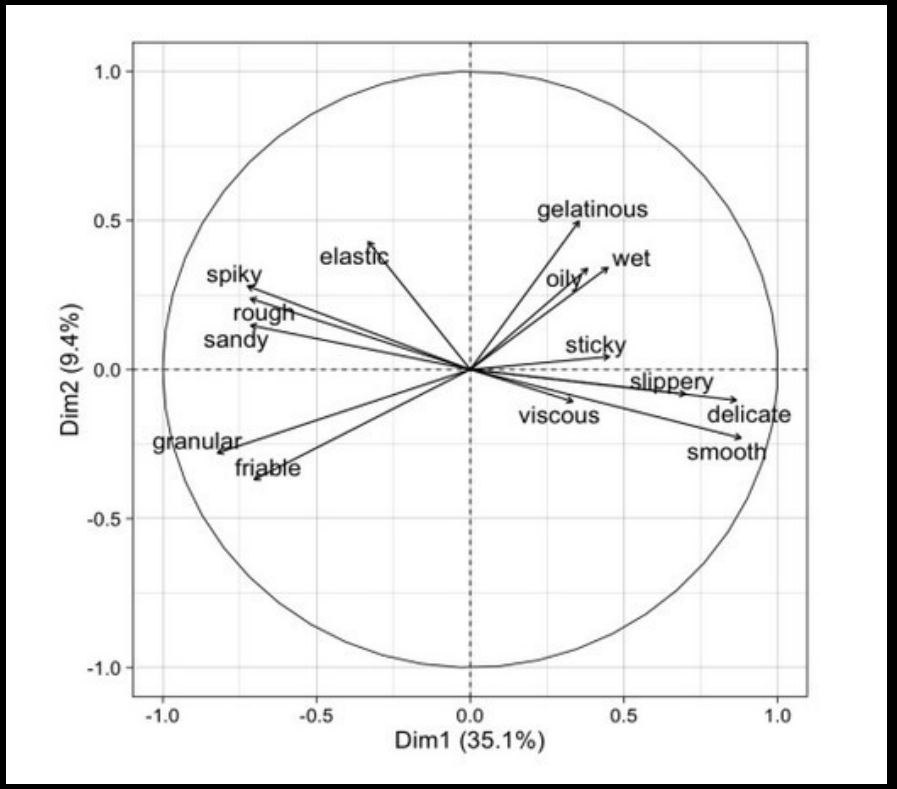


Investigating the semantic perceptual space of synthetic textures on an ultrasonic based haptic tabletM Dariosecq, P Plénacoste, F Berthaut, A Kaci, F GiraudHUCAPP 2020

Time to complete the task

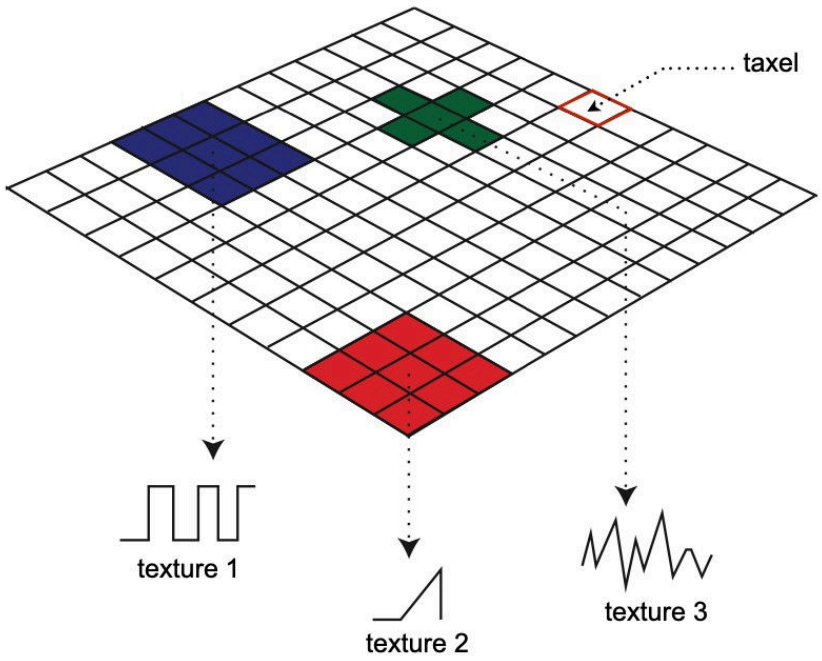
3 – To go out of the Lab

Investigating the semantic perceptual space of synthetic textures on an ultrasonic based haptic tabletM Dariosecq, P Plénacoste, F Berthaut, A Kaci, F GiraudHUCAPP 2020



Semantic Perceptual Space

3 – To go out of the Lab



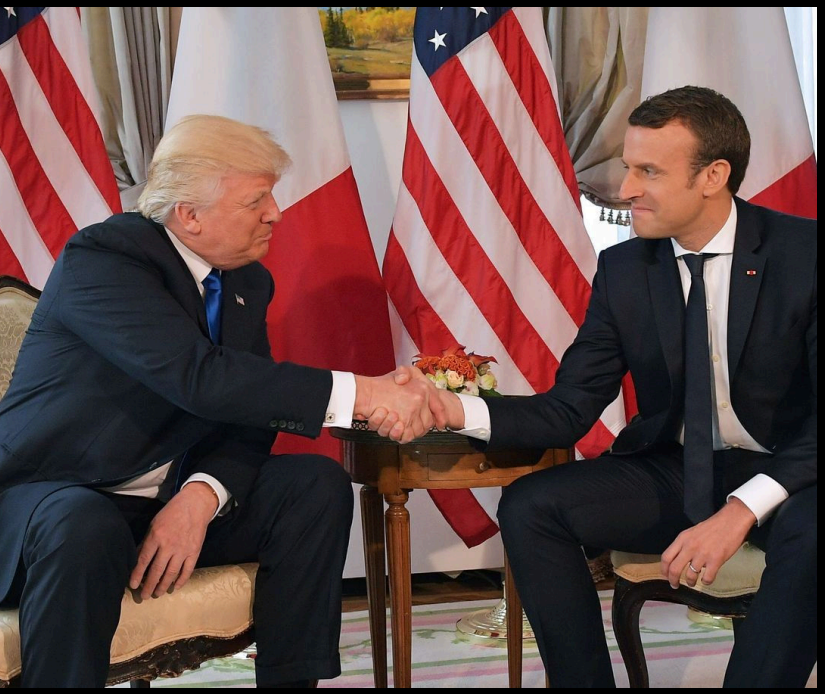
Localized Haptic Texture: A rendering technique based on Taxels for high density tactile feedback. Yosra Rekik, Eric Vezzoli, Laurent Grisoni and Fréderic Giraud.Proceedings of CHI'17, the 34th Conference on Human Factors in Computing Systems. 2017

Interhaptics
A RAZER COMPANY

Led to MPEG standard for Haptics

Le toucher, un sens complexe

Pour toucher, il faut produire un contact



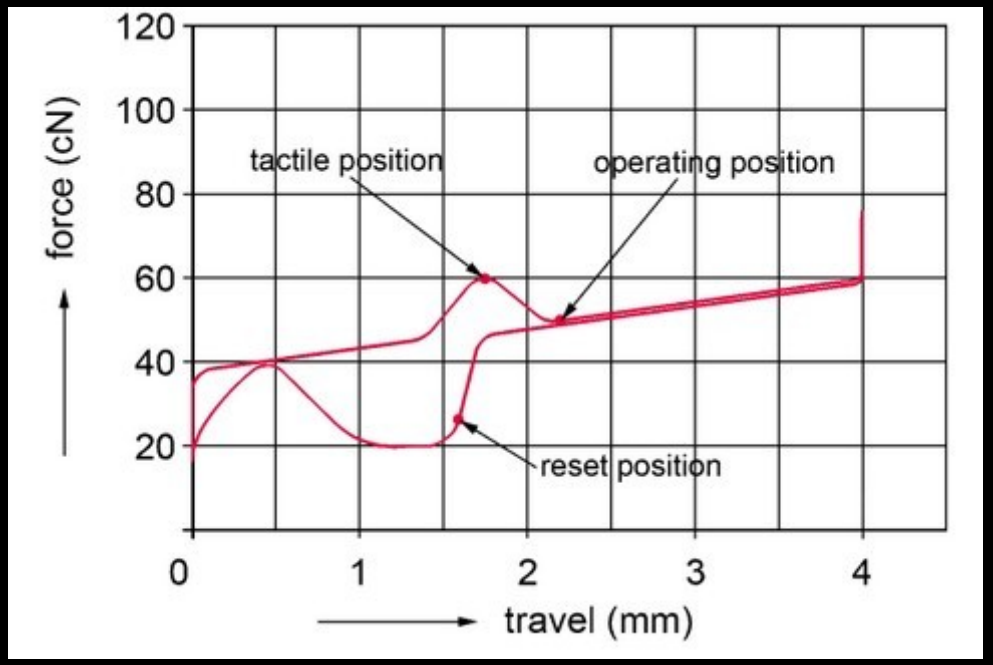
Conclusion

- The Tactile & Gesture interaction at IRCICA is an interdisciplinary team,
- The researchers are specialists in different scientific domains,
- They meet and collaborate around research projects
- It requires open minded researchers

2 – Humans are not machines

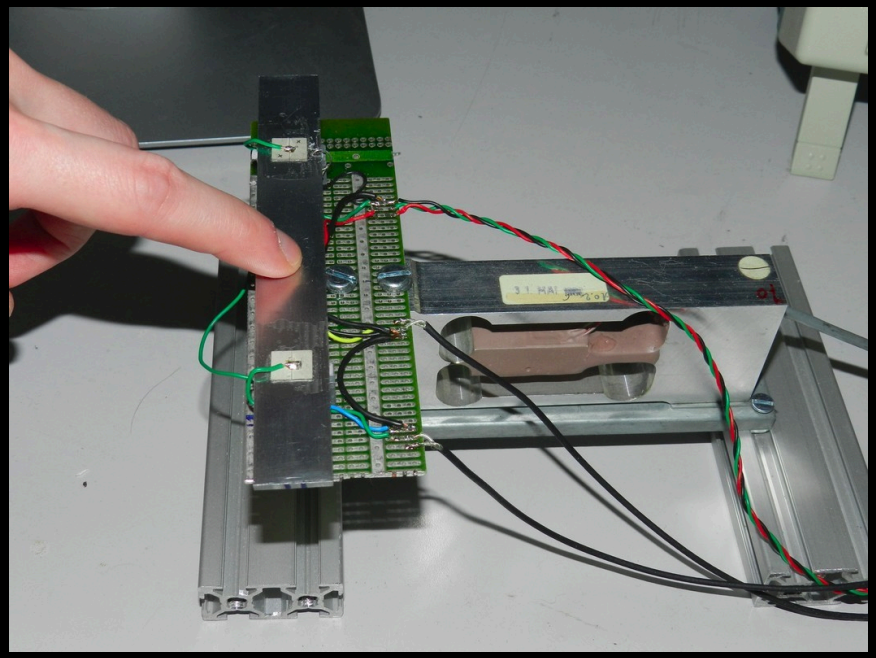
2 – Humans are not machines

We can measure the force/displacement curve



→ measurable performances

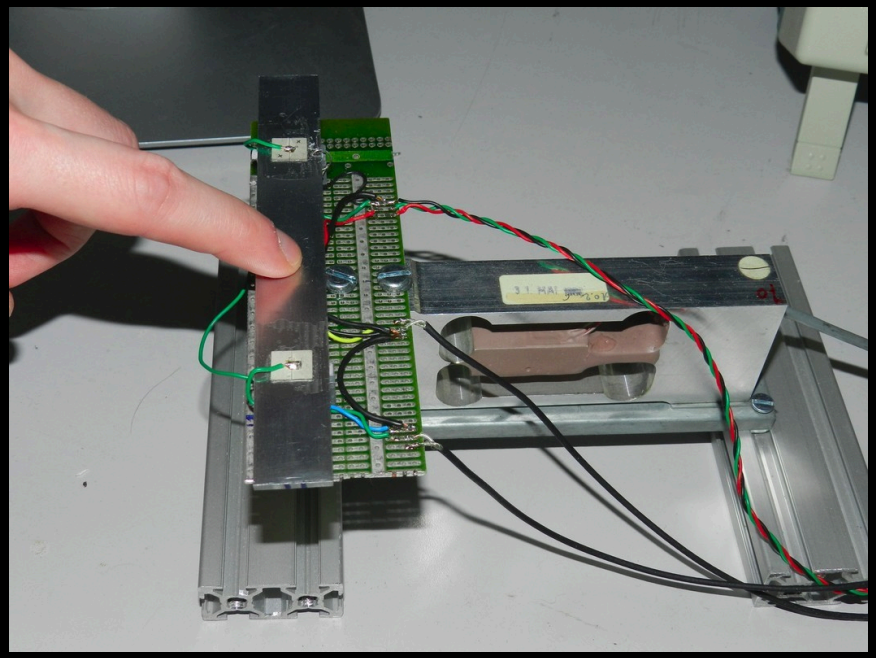
2 – Humans are not machines



Control of an ultrasonic haptic interface for button simulationP Garcia, F Giraud, B Lemaire-Semail, M Rupin, A KaciSensors and Actuators A: Physical 342, 113624

Ultrasonically induced lateral forces

2 – Humans are not machines



Control of an ultrasonic haptic interface for button simulationP Garcia, F Giraud, B Lemaire-Semail, M Rupin, A KaciSensors and Actuators A: Physical 342, 113624

Ultrasonically induced lateral forces