

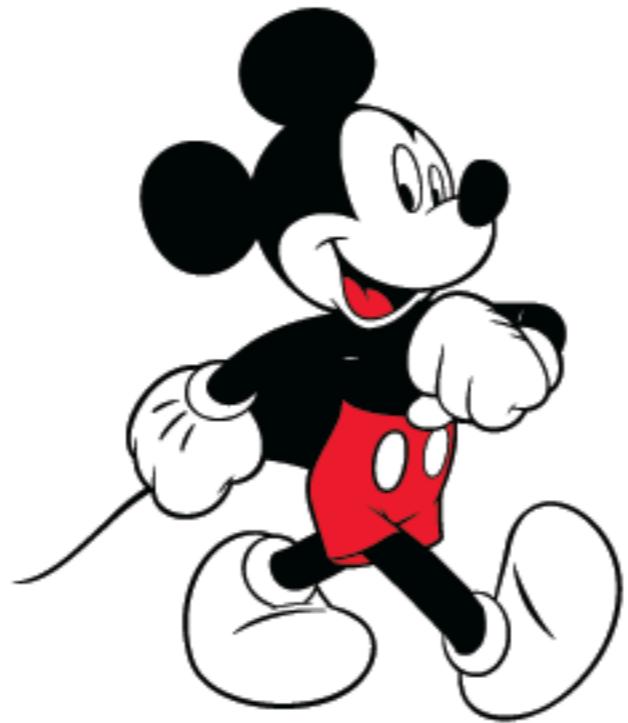
# Tactile Touch Panels: Why it is Hard and What is in the Future?

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*Disney Research, Pittsburgh, USA*

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# Disney Research Pittsburgh

I am a Senior Research Scientist in Disney Research Pittsburgh, one of the labs in Disney Research. I do research and manage Interaction Group there.



Started working on tactile  
touch screens in 2001.

**SONY**

I started working on tactile interfaces for touch screens before joining Disney when I was working for Sony corporate labs in Japan.



Sony Navitus (2003): The world-first consumer electronics product on market with tactile touch screen.

My and my colleagues research on tactile user interfaces was released on market in Sony products.

[About Navitus](#)[A/V Professionals](#)[Resources](#)[» DESIGN](#) [» FUNCTION](#) [» FEATURES/SPEC](#)

## Touchscreen with Feedback

Most touch screens are lifeless, it's often hard to know whether or not your command has even registered. The Navitus remote is dramatically different. Imagine an LCD screen that actually presses back against your fingertip to confirm each command.

## A Remote Control that Fits Every Individual

You can customize each screen, adding and deleting functions as you see fit. You can import JPEG and BMP images to design and personalize your individual LCD screen. You can choose different "skins," user interfaces that give each screen a whole new look.



## Multi-Component Screen

At Sony, we know that you don't use one component at a time. When you watch a DVD, you may need to control the DVD player, television, and A/V receiver simultaneously. That's why we designed the Navitus remote to display the functions of several components at once.

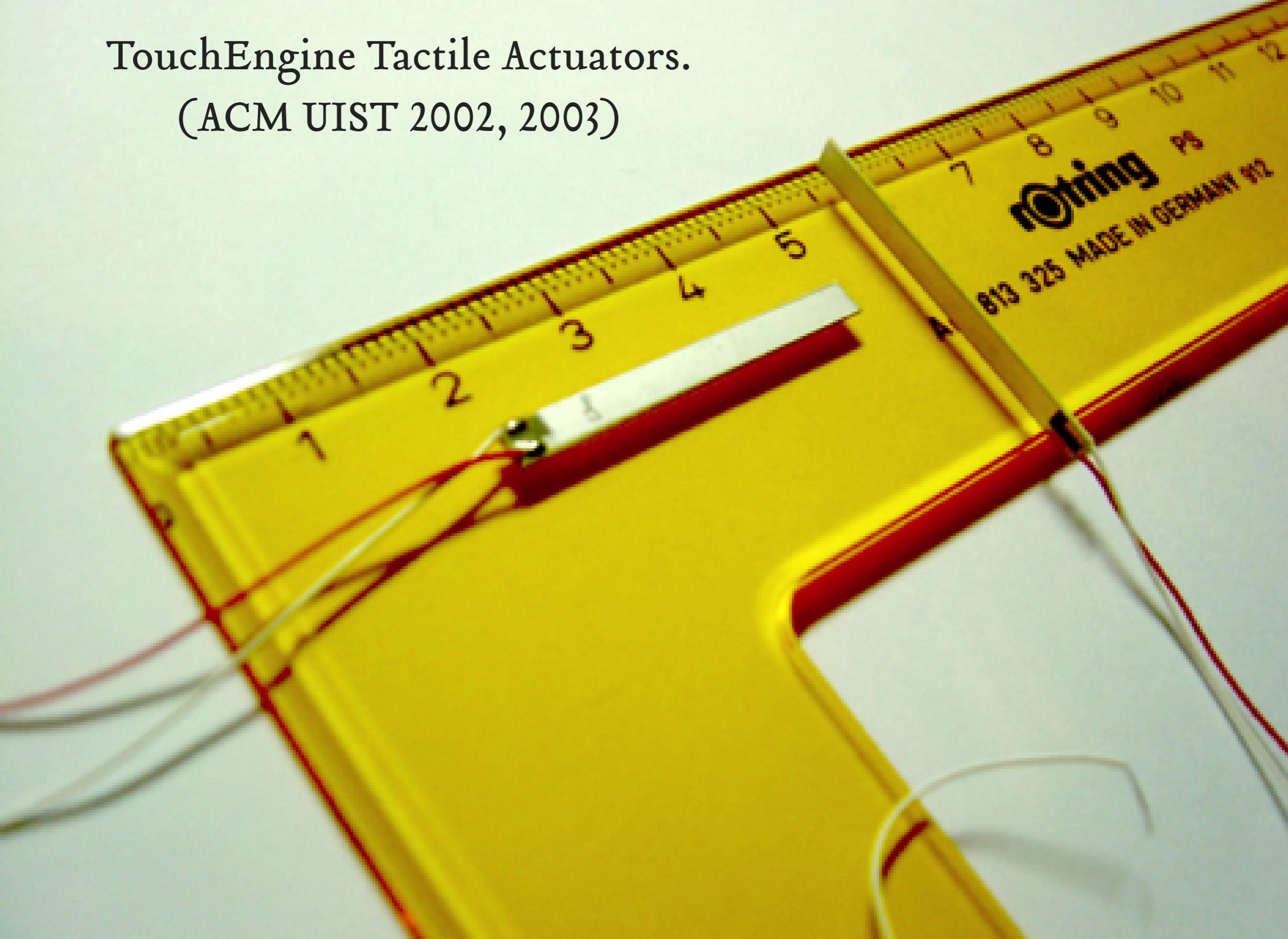
[» Learn About the Functions](#)

## Style & Size Matter

See how good it looks on your coffee table. Pick it up and feel how lightweight it is with its Aluminum front panel. Notice your commands displayed in 65,536 dazzling colors. Place it back into its docking station for recharging.

This is a sales materials where Sony is trying to explain what tactile feedback is. It was difficult since even touch screens were not widely used at that time.

# TouchEngine Tactile Actuators. (ACM UIST 2002, 2003)

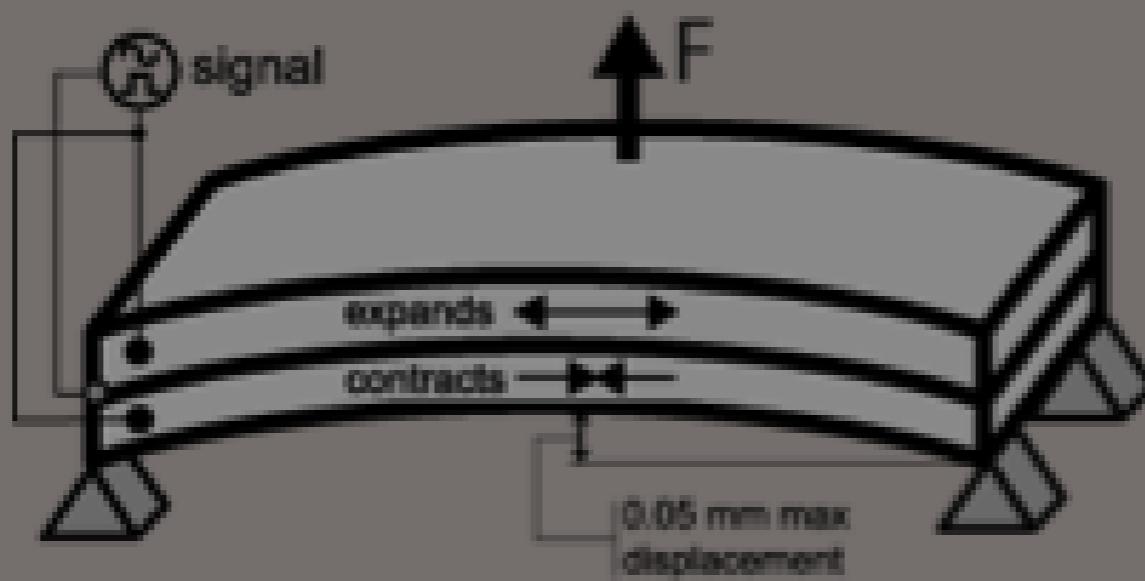


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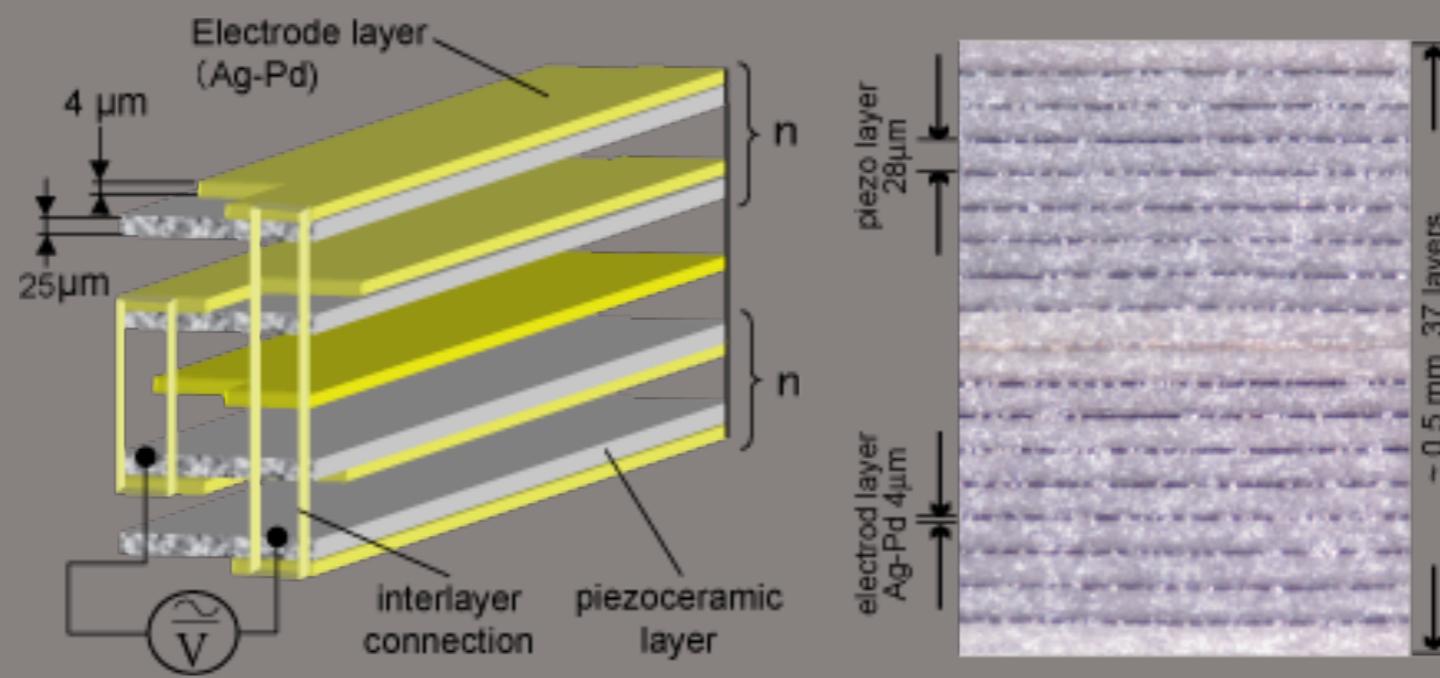
It was based on TouchEngine tactile actuators:

Poupyrev, I., S. Maruyama, and J. Rekimoto. Ambient Touch: Designing tactile interfaces for handheld devices. Proceedings of UIST'2002. 2002: ACM: pp. 51–60

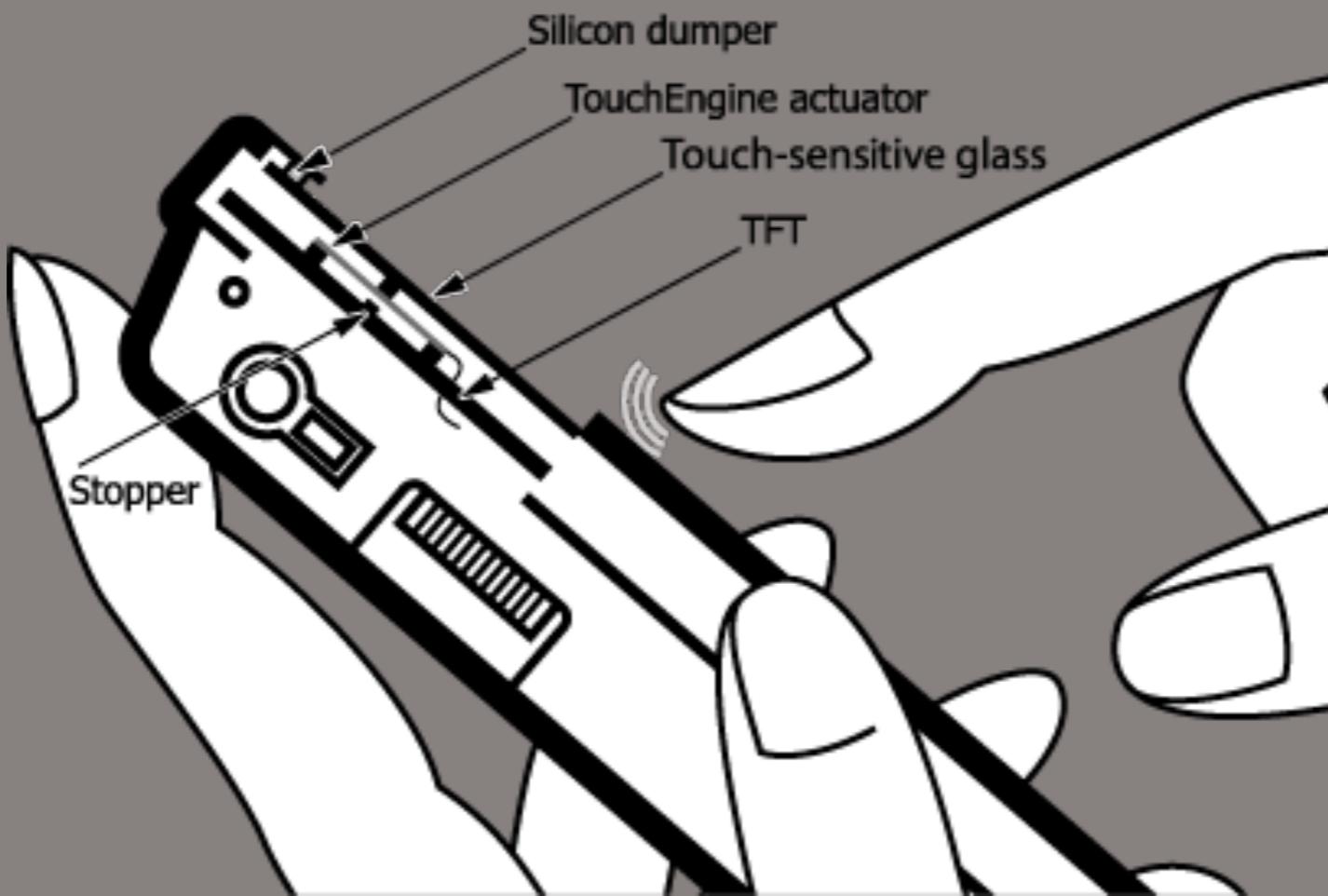
Poupyrev, I. and S. Maruyama. Tactile interfaces for small touch screens. Proceedings of UIST. 2003: ACM: pp. 217–220



TouchEngine tactile actuators are custom-made piezo actuators.



Multi-layer structure allows to lower voltage.



Highly localized tactile feedback.

The design of the tactile interface.

トップ &gt; ソニーグループ情報 &gt; ソニー(株)情報 &gt; プレスリリース &gt; 2005年のプレスリリース

ソニー(株)情報 | 投資家情報 | CSR・環境・社会貢献 | 採用情報 | プレスリリース | 技術情報

## ソニー(株)情報

## Corporate Information

## 報道資料

ここに掲載されている情報は、発表日現在の情報です。検索日と情報が異なる可能性がございますので、あらかじめご了承ください。

ソニー・マーケティング(株)宛表の広報宛表文は[こちらの目次](#)をご覧ください。

2005年10月25日

タッチエンジン<sup>TM</sup>※1 モジュールを商品化

～ 低電圧駆動方式によりモバイル機器に最適なモジュールを実現 ～

ソニー株式会社は、低電圧で駆動が可能な積層圧電素子<sup>※2</sup>を用いた触覚ヒューマンインターフェースモジュール、「タッチエンジン<sup>TM</sup>モジュール」を発売、11月中旬よりサンプル出荷を開始します。

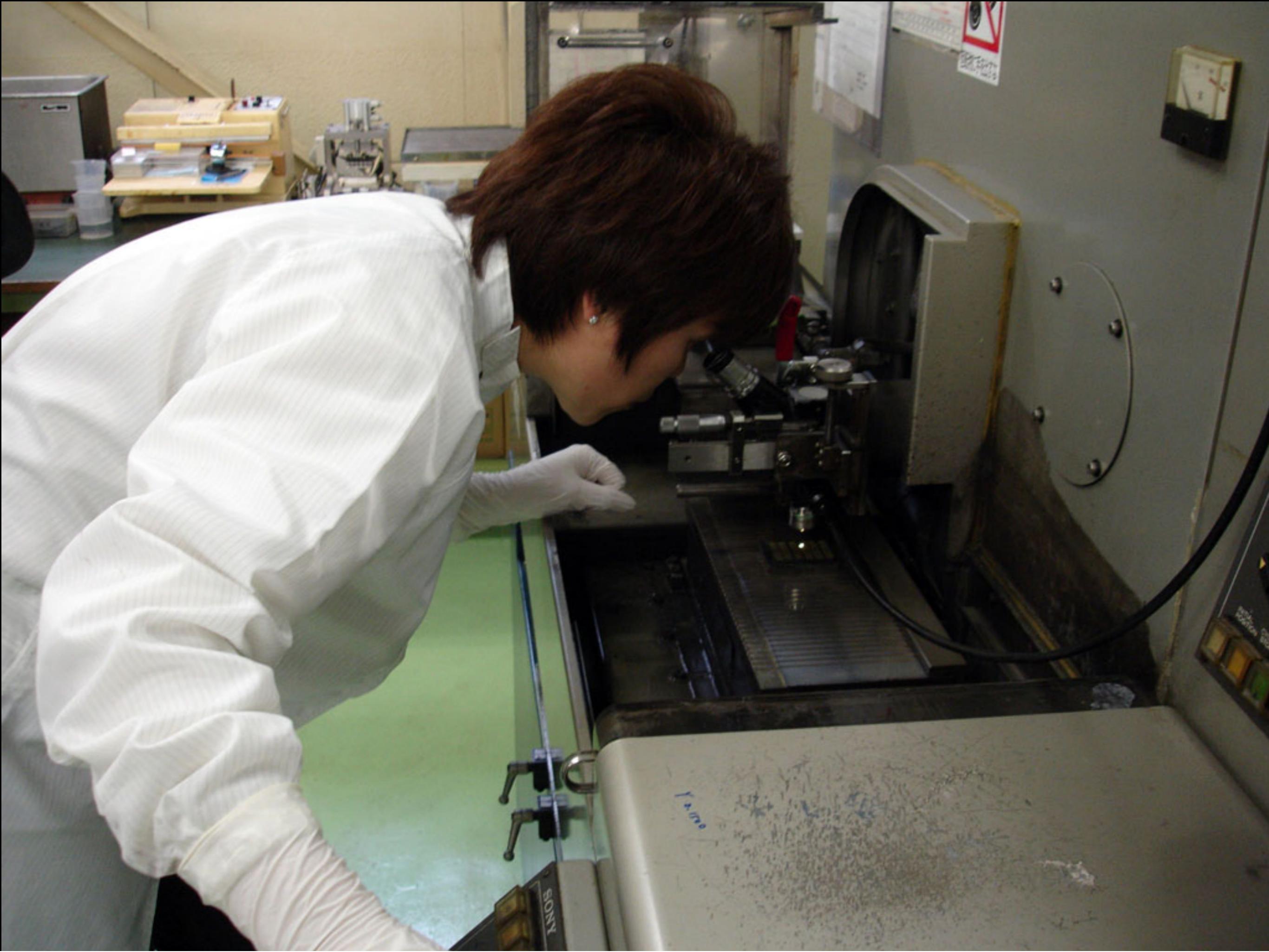


振動テーブル部(3インチサイズ)(左)(外形寸法 縦45×横63×厚さ1.9mm)と  
駆動回路(右)(外形寸法 縦20×横24×厚さ2.3mm)のタッチエンジン<sup>TM</sup>モジュールパッケージ

デジタルスチルカメラなどの様々な製品にディスプレイデバイスが採用されるにつれ、直感的に指先で触れて操作を行うことができるタッチパネルや入力センサの搭載が多くなってきています。今回商品化するタッチエンジン<sup>TM</sup>モジュールは、タッチパネルなどと組み合わせることで、クリックなどの操作に対し指先に振動を伝え、ユーザーへ確実な操作の感覚を生み出すものです。

低電圧で駆動が可能な『積層圧電素子』を採用することによってモバイル機器に適した低電圧での駆動を可能にしています。また、本モジュールは、タッチパネルを簡単に搭載できる構造により、あらゆる機器への搭載を可能にします。

TouchEngine was on sale as component for other companies to use. In this reference platform the actuator was set up so that it would vibrate small screen in horizontal direction. You can also see a control board that I designed, which was rather small.



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Production of the actuators.



Launch of TouchEngine production at Sony factory in Japan.

Navitus RC taken off the market in 2005.

TouchEngine production shut down in 2007.

Team disbanded in 2009.

Never restarted.

Why?

Why tactile touch screens  
are difficult?

## 1. Being first is often bad.

Touch screens were niche technology until iPhone ('07).  
New interface paradigm:  
touch screen only controls.

The main contribution of iPhone was not that it used touch screen or multi touch. The most profound impact of iPhone was that it proved that it possible to create successful consumer products without using any physical buttons.

[About Navitus](#)[A/V Professionals](#)[Resources](#)[DESIGN](#) [FUNCTION](#) [FEATURES/SPEC](#)

## Color LCD Screen

All your choices will be big, bright and beautiful on Sony's 3.5-inch Thin Film Transistor Liquid Crystal Display. Sony's 65,536 colors make your keys, your wallpaper images and your graphic interfaces look their best.

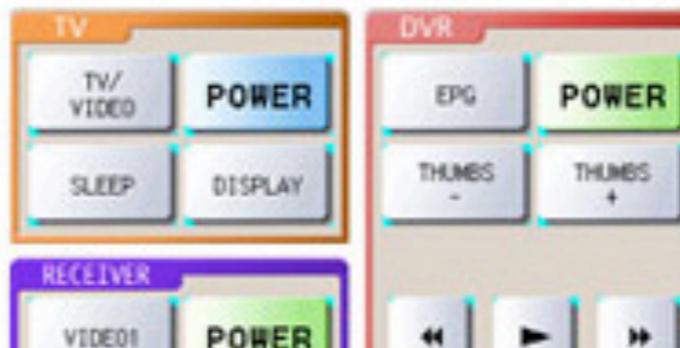
## Tactile Response Display

Most touch screens are lifeless and inert. It's often hard to know whether or not your command has even registered. The Navitus remote is dramatically different. Imagine an LCD screen that actually presses back against your fingertip to confirm your command!

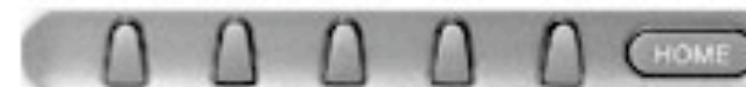
With TouchEngine® Technology, you're operating with confidence.



## Multi-Component Screen



## Direct Access Buttons



Using your PC and the supplied Navitus software, you can program the RM-NX7000 with keys that will jump from one operating screen to another.

Before iPhone consumer electronic industry would not design touch screen-only devices. The assumption was the users always want buttons and will never use touch screen only devices. For example Sony remote controller that had tactile feedback for touch screen had entire functionality replicated by physical buttons.



Ericsson R380 (1993?)



IBM Simon (1993)

Although this view now seems misguided, it is important to remember that before iPad all products that attempt to have touch screen only interface were not successful.

## 1. Being first is often bad.

Touch screens were niche technology until iPhone ('07).

New interface paradigm:  
touch screen only controls.  
Shifting from purely button  
presses to continuous gestures.

I also believe that we are shifting away from seeing touch screens only as easy replication of buttons, and completely new interface style is emerging that is based on gestures.



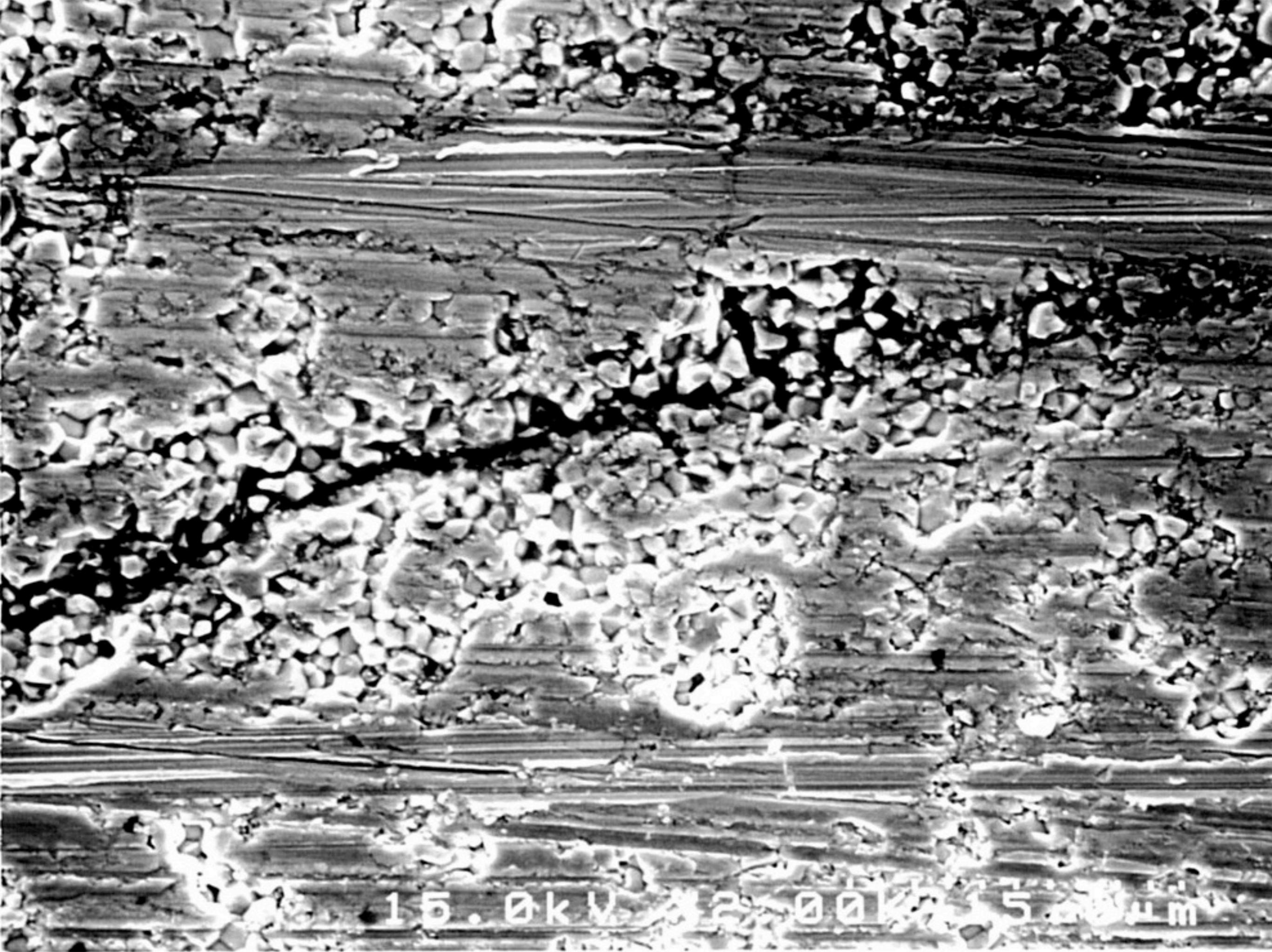
## 1. Being first is often bad.

Touch screens were niche technology until iPhone ('07).  
New interface paradigm: touch screen only controls.

Shifting from purely button presses to continuous gestures.  
Vibrotactile feedback isn't

## 2. Mechanical motion.

Dust sealing. Noise. Actuator  
size. Reliability.



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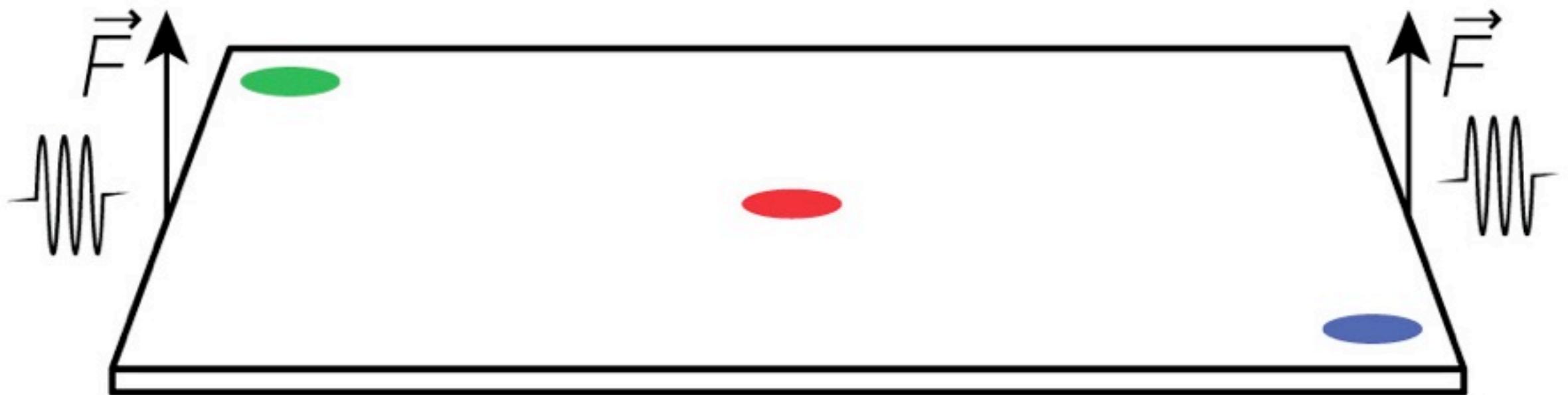
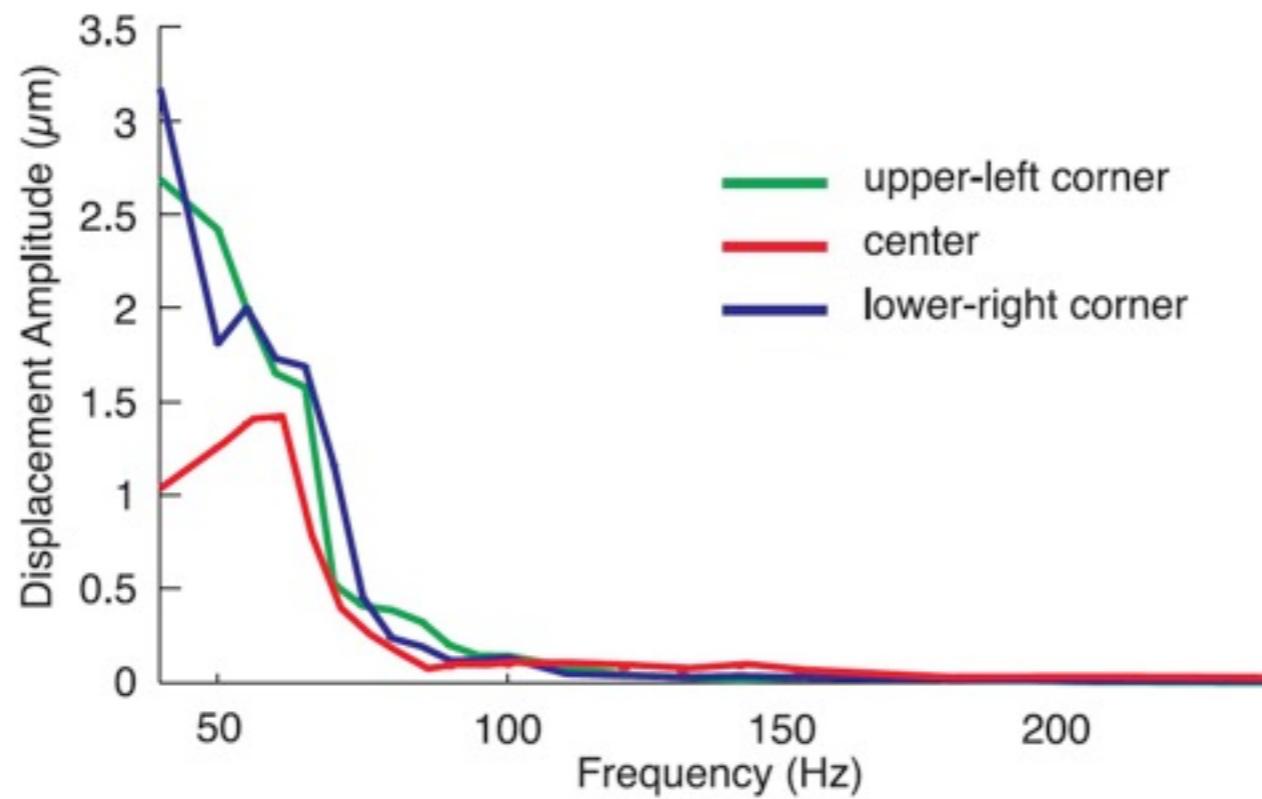
Reliability of mechanical actuators is a difficult problem. This is mechanical crack as seen in microscope in the TouchEngine actuator prototype that would develop after about 30000 uses. Consumer electronics industry hates recalling their products.

## 2. Mechanical motion.

Dust sealing. Noise. Actuator  
size. Reliability.

Non-uniformity of tactile  
feedback in space and  
frequency domains.

# Signal attenuation at different frequencies



The touch panel displacement would be different at different frequencies. The response of the system would depend on many variables.

# Spatial non-uniformity



Sensation will be different in different places in the panel. Vibrating panel horizontally would solve this problem but introduces a range of other problems, such as need for more power.

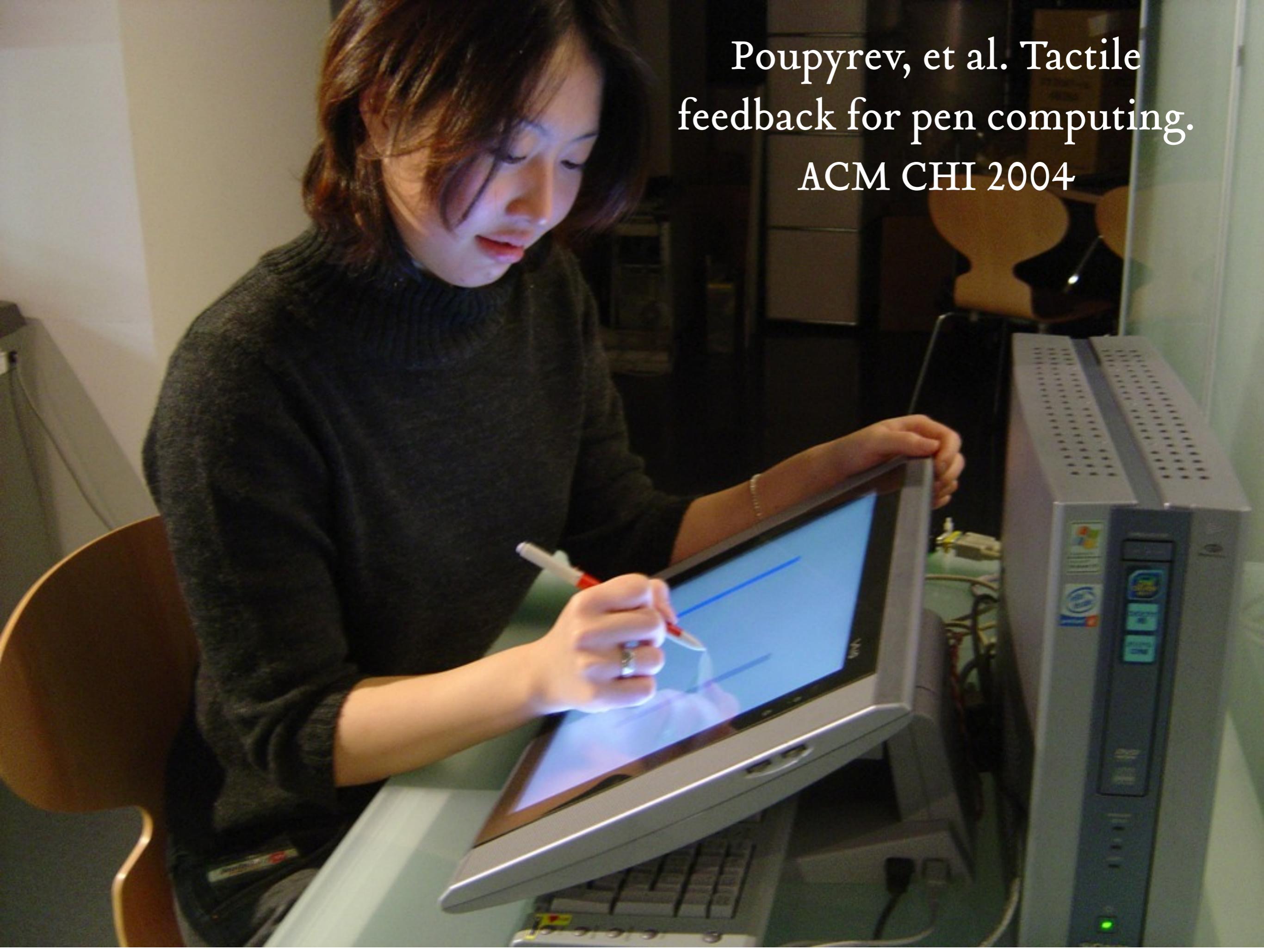
## 2. Mechanical motion.

Dust sealing. Noise. Actuator size. Reliability.

Non-uniformity of tactile feedback in space and frequency domains.

Limits on size of panels.

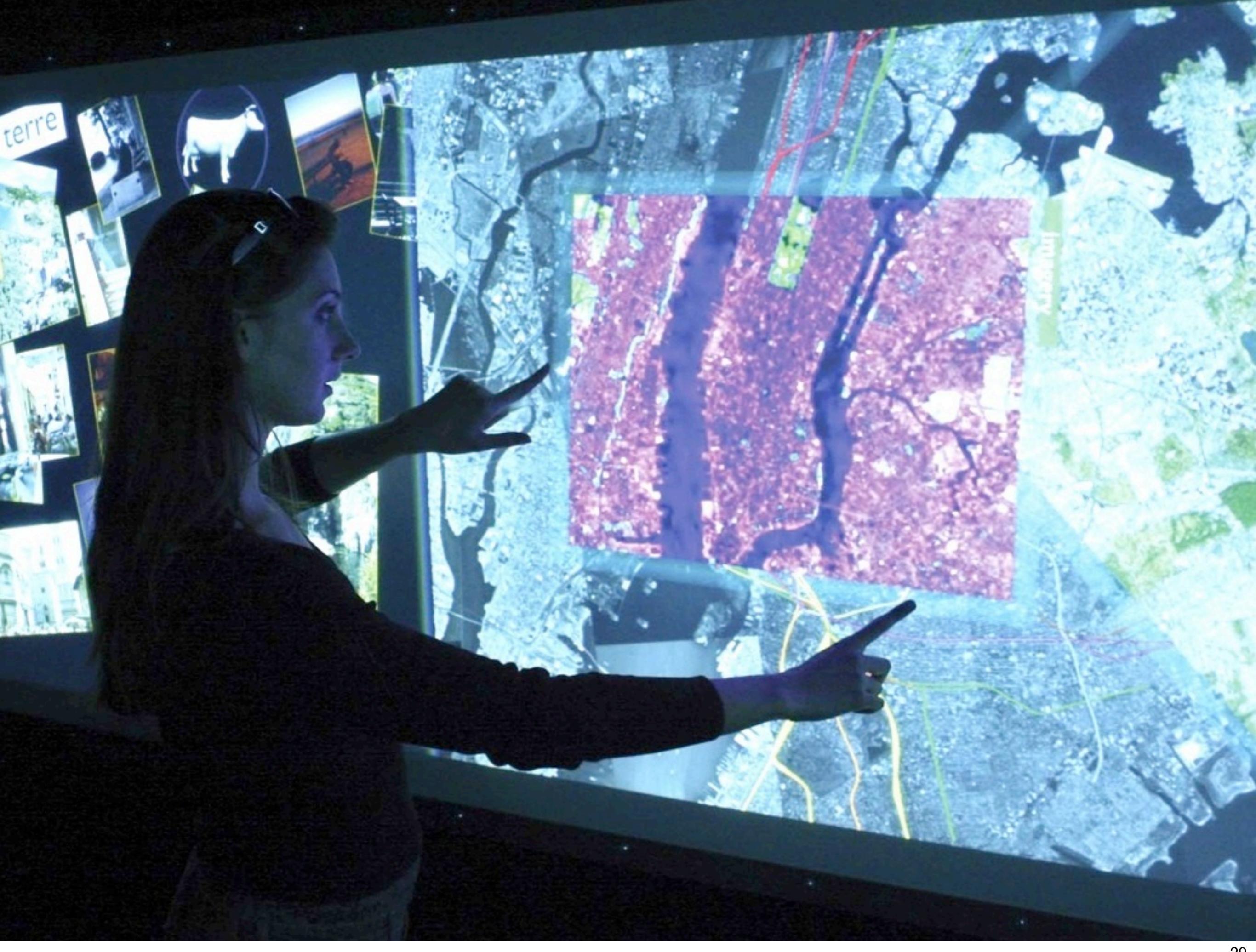
Poupyrev, et al. Tactile  
feedback for pen computing.  
ACM CHI 2004



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This is nearly the largest panel that we were developed vibrotactile tactile feedback for. As we increase the size of the panel providing vibrotactile feedback becomes more difficult.

Poupyrev, I., M. Okabe, and S. Maruyama. Haptic Feedback for Pen Computing: Directions and Strategies. Proceedings of CHI'2004. 2004: ACM: pp. 1309–1310



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Providing vibrotactile feedback to wall-size touch interfaces is not practical.

### 3. Design challenges.

How to do tactile feedback  
and yet have a robust and  
attractive product? Can not  
glue to screen!

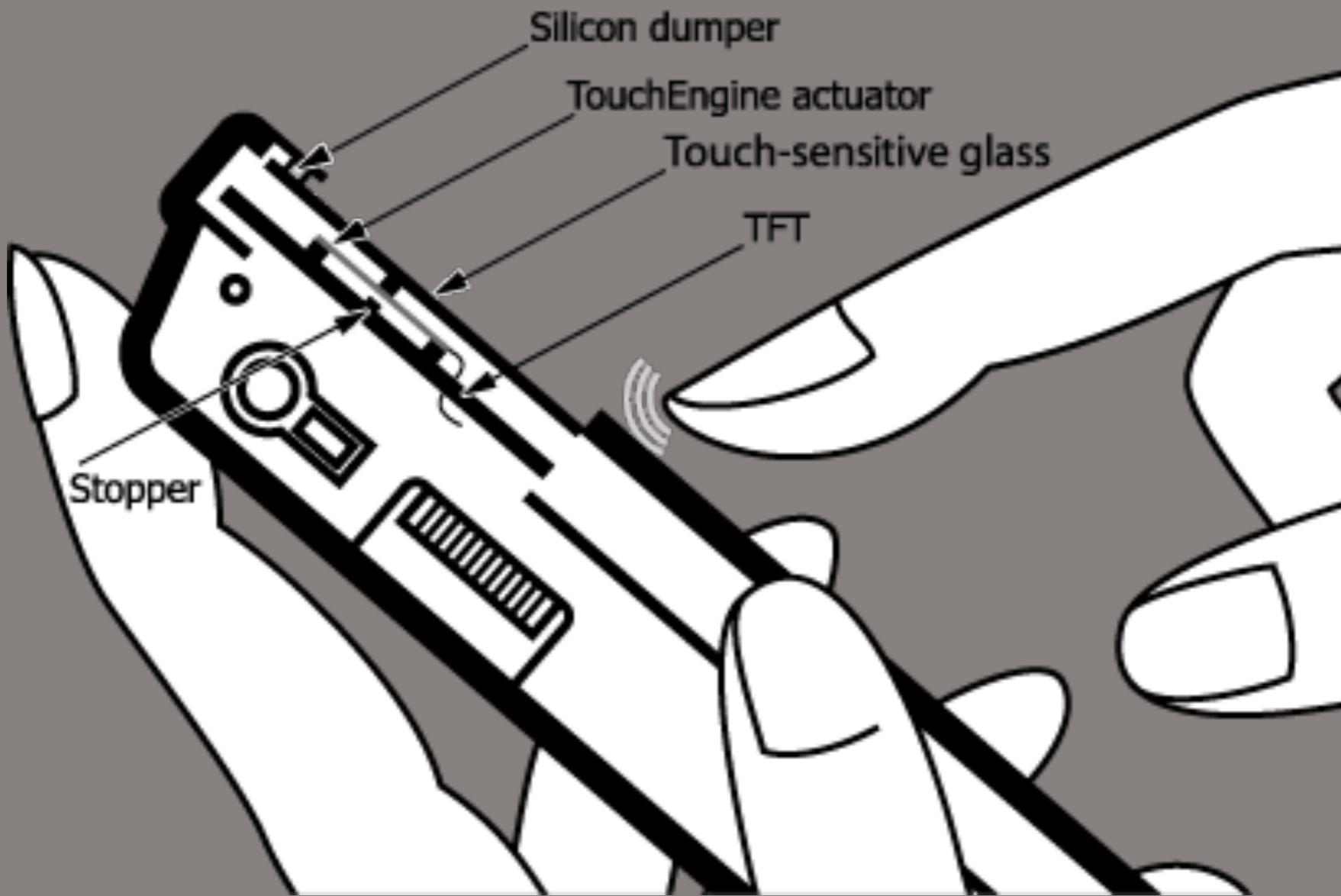


Design is important consideration in consumer products. Moving parts, such as tactile screens, place limitation on what designers can do.

### 3. Design challenges.

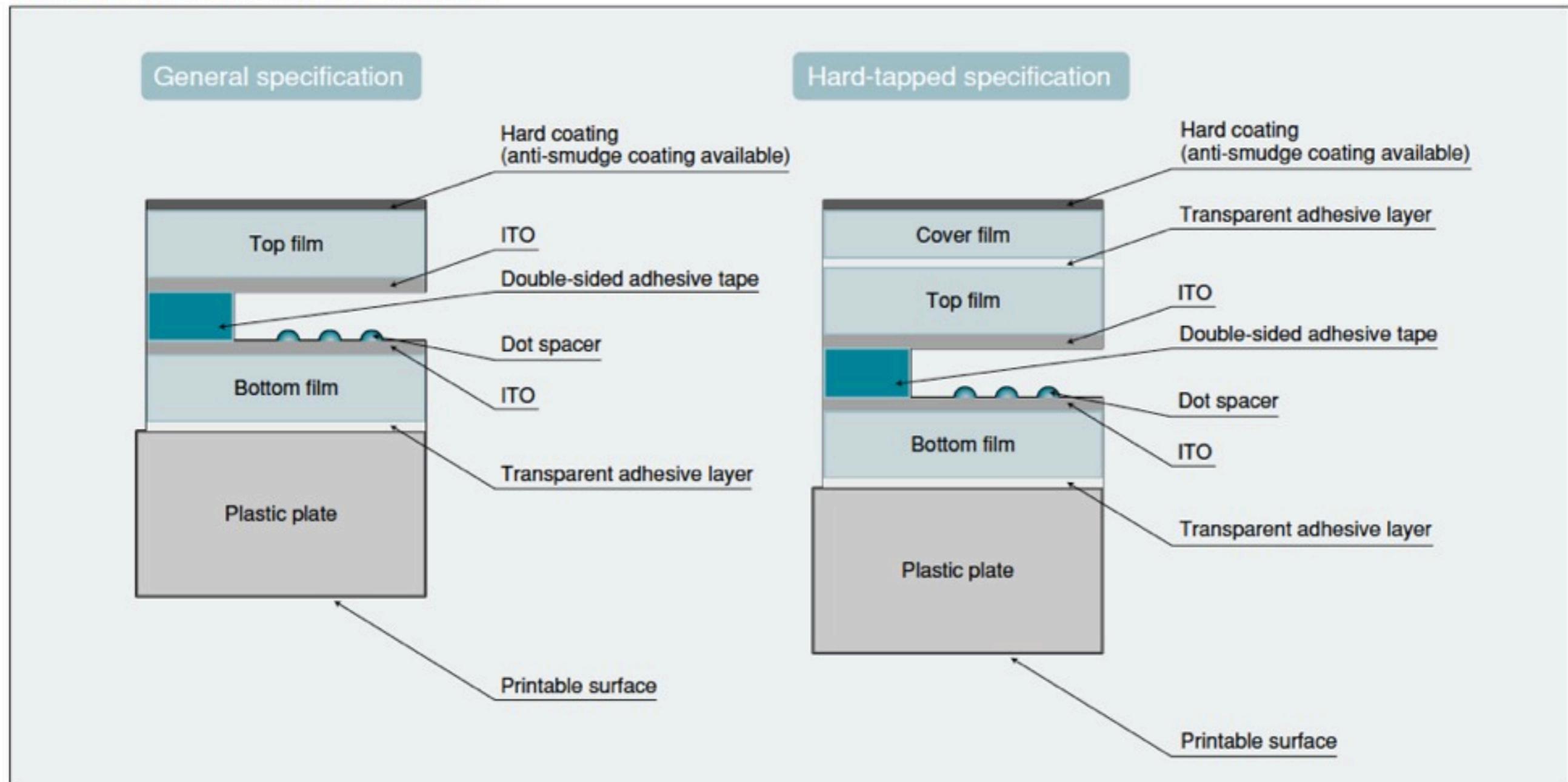
How to do tactile feedback  
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attractive product? Can not  
glue to screen!

New screen and input  
technologies. What do we  
vibrate?

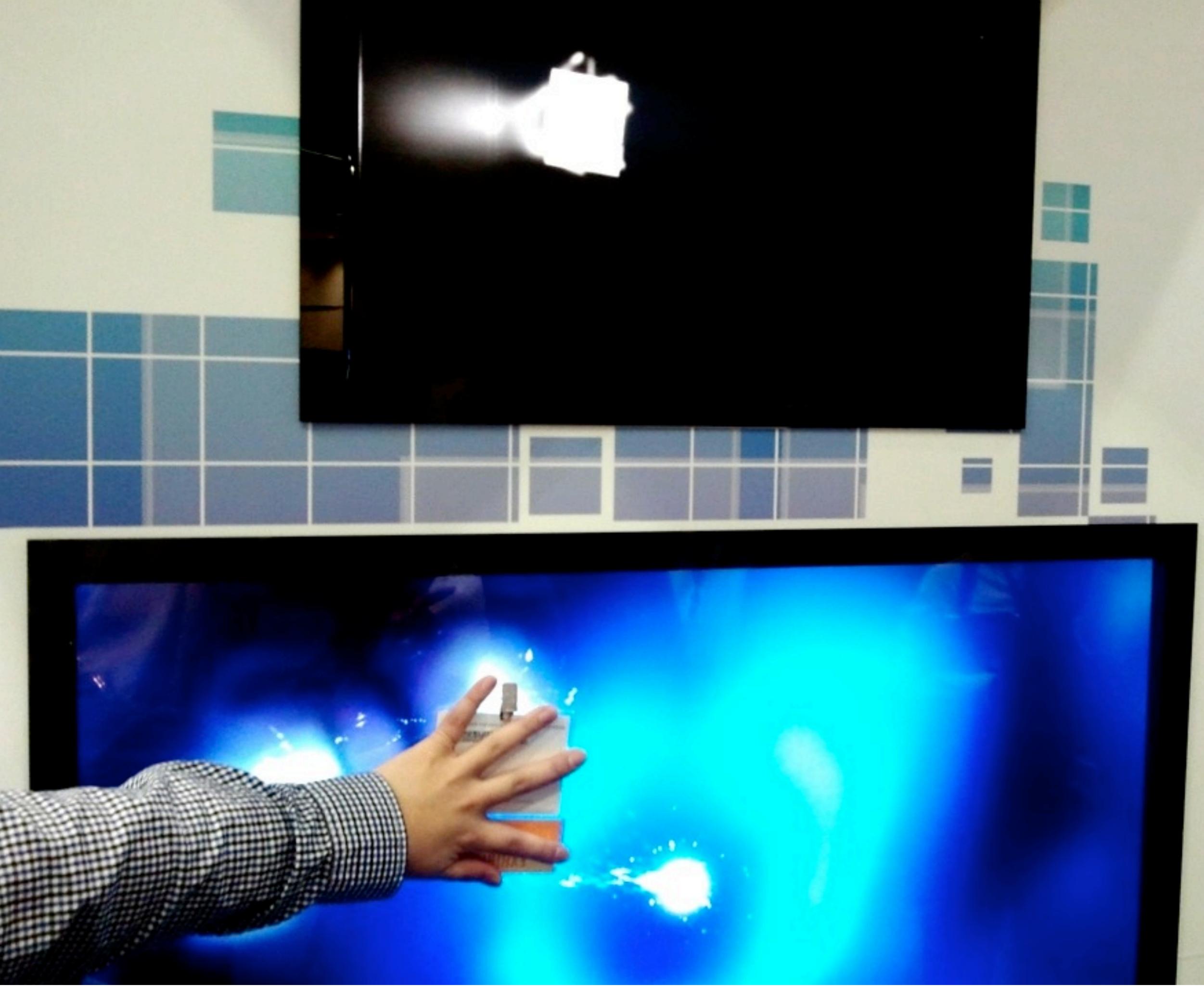


Early touch screen interfaces used resistive sensor on a separate glass plate. It was stiff, light and easy to vibrate.

**Figure 1** Cross-section Structure of FFP Touch Panel



Recent resistive touch screens are flexible, and can not be vibrated.



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Some of the emerging tactile technology does not have separate touch input at all, for example in Samsung in-cell sensing displays the display can both create image and sense light in the same hardware. What we are going to vibrate here? The entire display? Add extra piece of glass to vibrate?

## 4. Business challenges.

Cost. Should be \$2-3.

Tactile feedback is not seen as crucial to product success.

“What features would not work without tactile feedback?”

Invisible, e.g. not marketable feature.



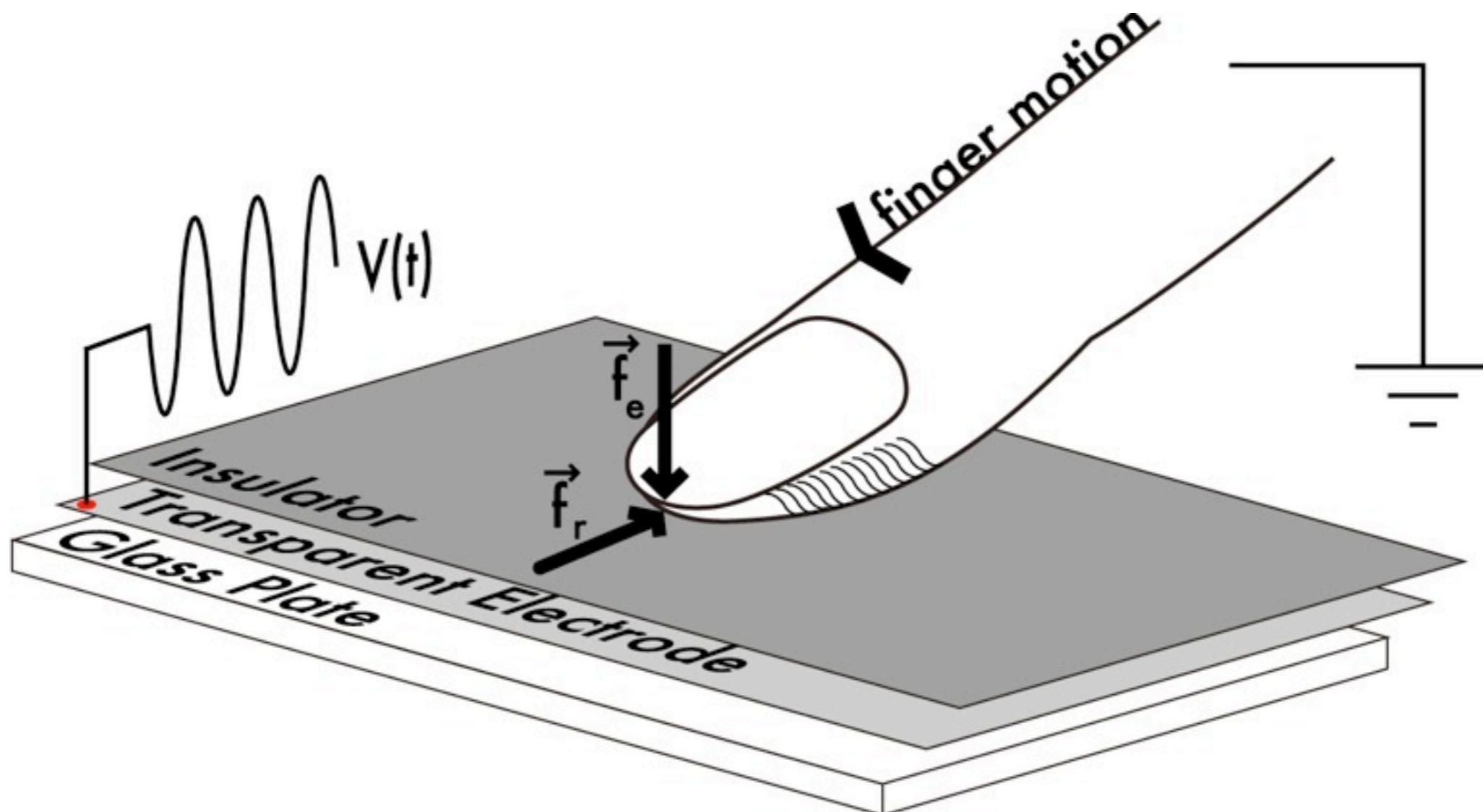
How tactile interfaces can be seen on the shop window? They are invisible. It is very difficult to sell features that consumer can not see.

## Future directions.

1. Tactile feedback for touch screens with no mechanical motion.

Tesla Touch 2010 by Disney  
Research Pittsburgh.

# TeslaTouch: Tactile touch screen based on electrovibration (ACM UIST 2010)



Demo at WHC 2011!

Bau, O., Poupyrev, I., Israr, A., Harrison, C. TeslaTouch: Electrovibration for Touch Surfaces. Proceedings of UIST 2010: ACM: pp. 283-292



Screen of virtual any size can be enhanced with tactile feedback.

## Future directions.

1. Tactile feedback for touch screens with no mechanical motion.

Tesla Touch 2010 by Disney

Research Pittsburgh.

Demo at WHC 2001.

What else: ultrasound? MEMS?

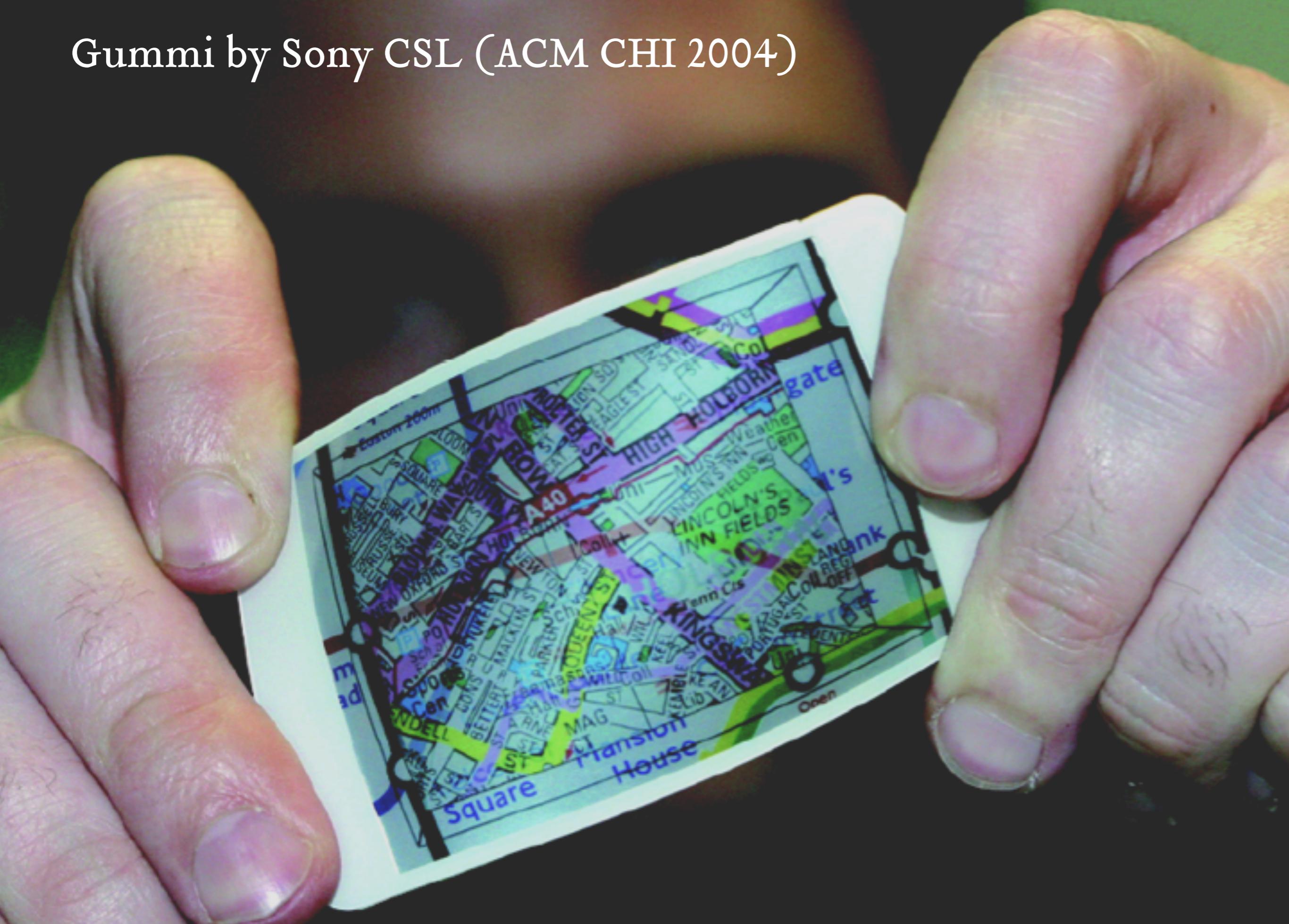
## Future directions.

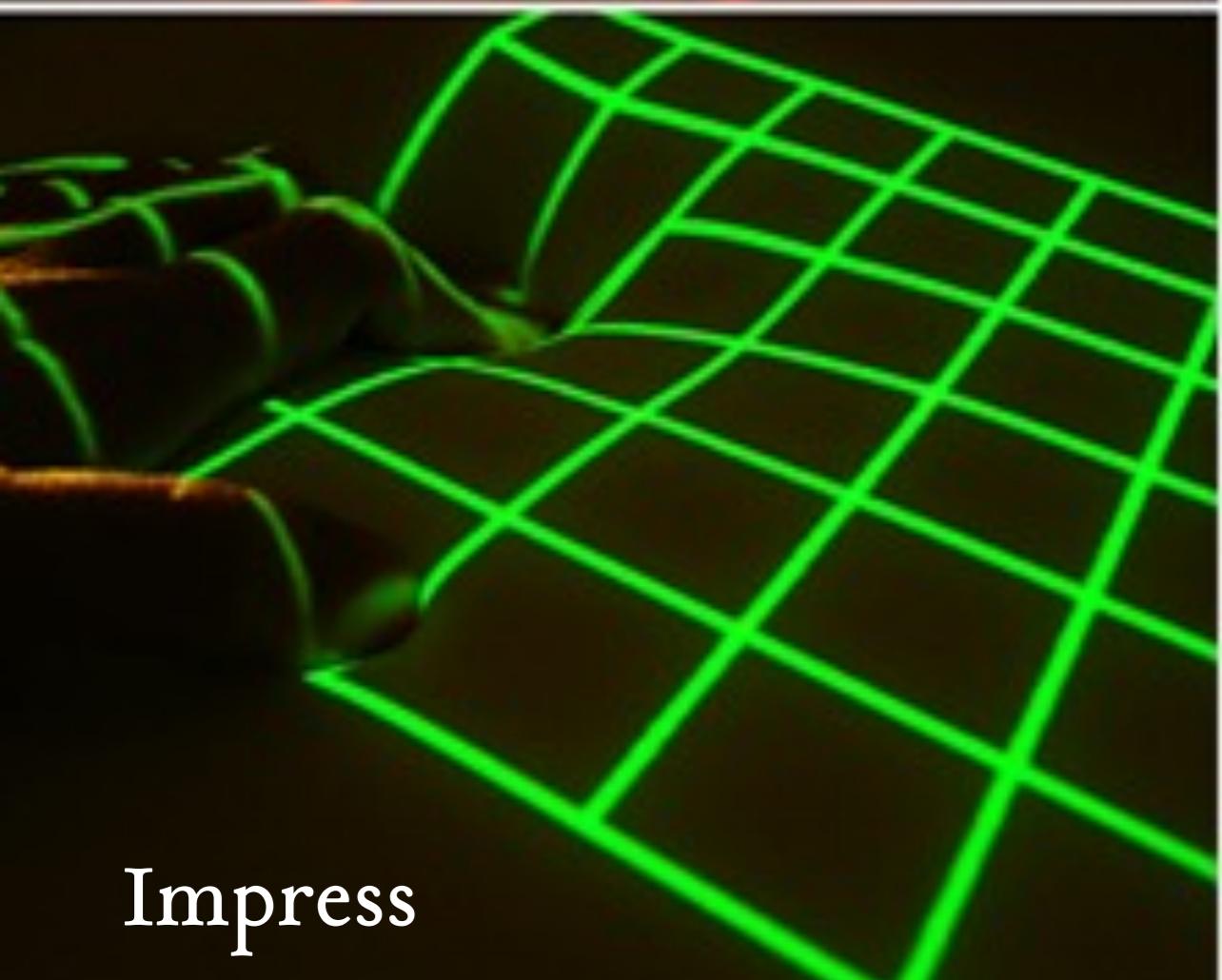
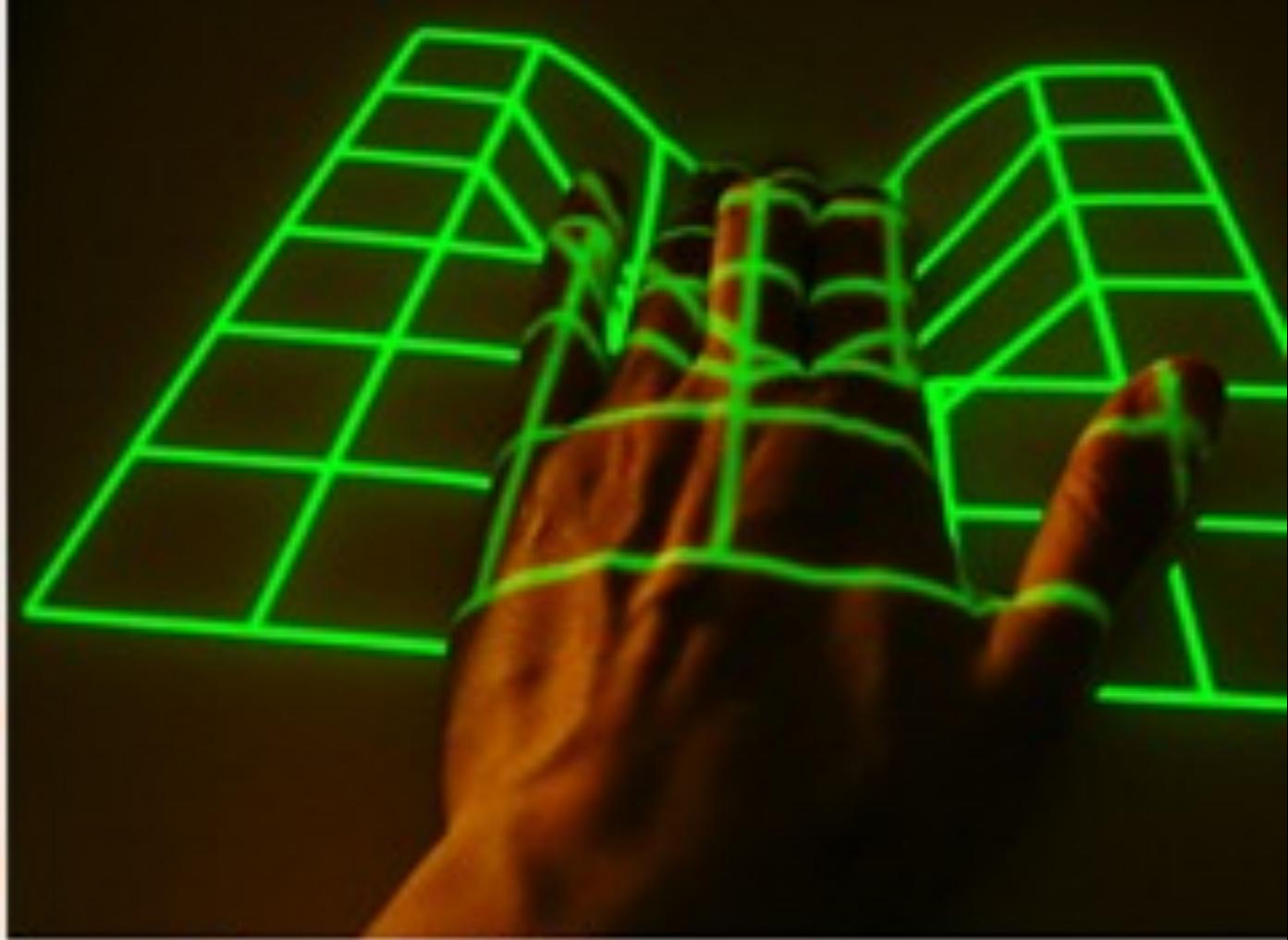
2. Tactile feedback is an inherent part of the interaction.

Bendable computers.

Deformable touch screens.

# Gummi by Sony CSL (ACM CHI 2004)





Impress

## Future directions.

2. Tactile feedback is an inherent part of the interaction.

Bendable computers.

Deformable touch screens.

Physical deformations provide inherent tactile feedback.

## More information

[www.ivanpoupyrev.com](http://www.ivanpoupyrev.com)

[www.teslatouch.com](http://www.teslatouch.com)

Come to see TeslaTouch demo.

Also: Ali Israr (Disney) paper presentation on tactile illusions  
(Friday, 11 am)