What Is Haptics? Part 1. Tactile Feedback

This is the first post in a series on the basics of haptic technology and perception. This installment focuses on tactile feedback. Subscribe to our newsletter to get these delivered straight to your inbox.

Jake Rubin

CEO & Founder

Six months ago, most people would have had to look up the word haptics. Now, it seems to be on everyone's lips in the world of VR and AR. The definition of the word "haptics" is straightforward: technology that interfaces with a user through their sense of touch. But what does "haptics" really mean?

Part of the challenge in understanding haptics is that the sense of touch encompasses a broad range of different sensations spread across the entire body. These sensations can be broadly grouped into a few "sensory channels," each perceived by a distinct subset of biological receptors located throughout the skin and other soft tissue. These sensory channels include: tactile, vibrotactile (vibration), force, and thermal. I'll dive into each of these channels and the haptic technologies associated with them in other blog posts. For now, let's start with tactile feedback.

Tactile Feedback

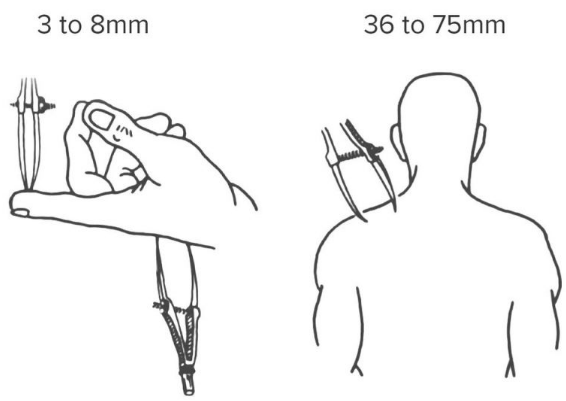
your skin. These patterns of pressure are picked up by tiny receptors spread throughout the skin, and interpreted by the brain into a rich array of sensations.

The tactile feedback channel is the primary source of information about the fine shape and object. It also contributes to perception of weight, size, and texture. For most interactions, tactile feedback is the most dominant component of haptic perception.

> *"For most interactions, tactile feedback is the dominant component of haptic perception."*

Tactile Feedback

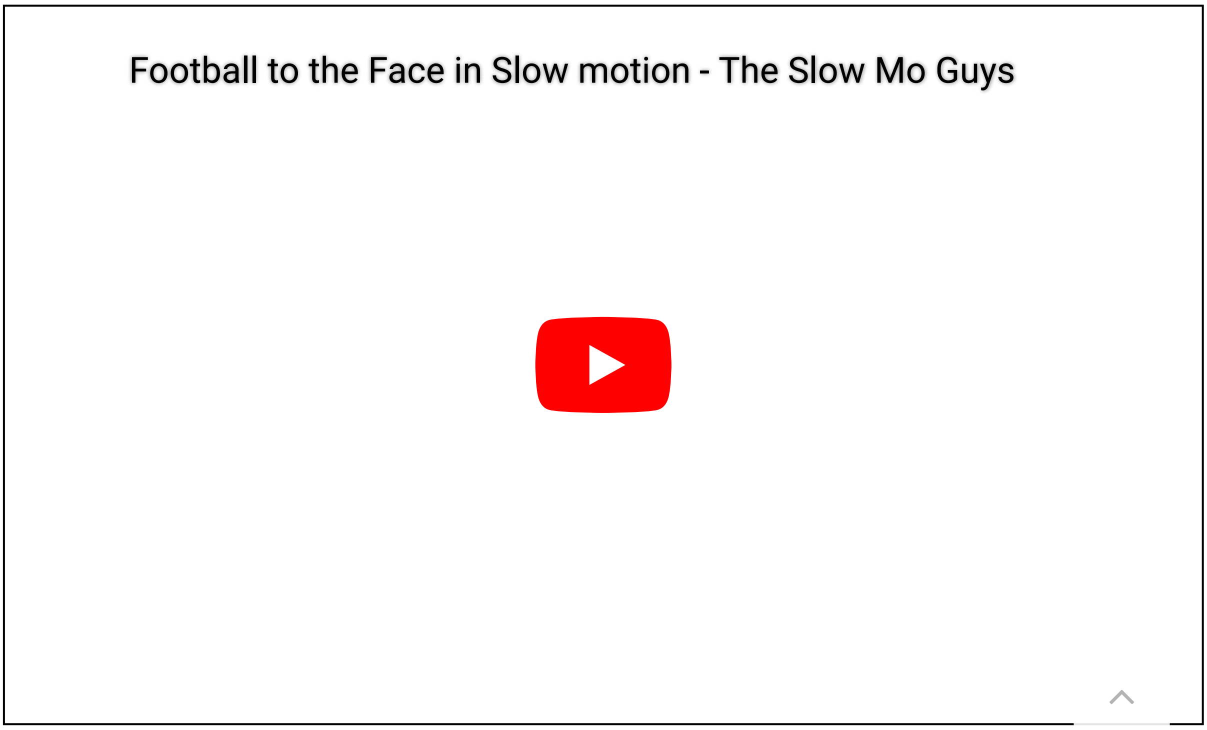
Unfortunately, tactile feedback is also in many ways the most challenging for today's haptic devices. Tactile feedback devices rely on a grid of "pixels" spread across the surface of a person's skin to reproduce tactile sensations. Each pixel consists of an actuator that's capable of producing controlled pressure on the skin. The way this works is analogous to a computer monitor. Monitors display images that appear continuous to our eyes by using a grid of many discrete pixels, each of which can change its color. Tactile feedback devices create sensations on the surface of the skin that appear continuous using many discrete actuators, each of which can change its pressure.



identified by studying the physiology and psychology of tactile perception. For example, a measurement called the "two-point threshold" determines the resolution of human tactile perception. The two-point threshold varies from less than 2 mm at the tip of the index finger to as much as 70 mm across the torso. This means that you would need over 1000x as many ...iven area of the fingertip versus the same area on the torso! As you ...ficult to pack so many actuators into such a small space in a device that is still practical to wear.

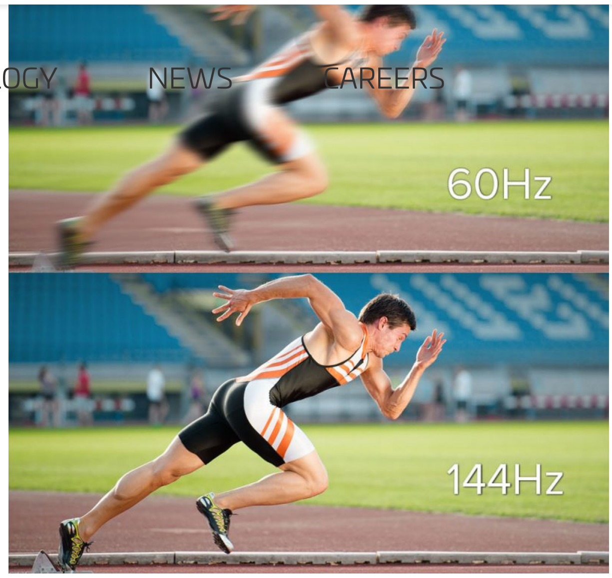
To make things more challenging, each actuator needs to have a significant amount of displacement. The skin is not a rigid surface. If fact, parts of the skin deform by up to several centimeters when a significant amount of pressure is applied. This means that no matter how hard the actuator can push, it has to be able to move quite far to apply a meaningful pressure to the skin. In practice, this means the actuator at each pixel must create a lot of motion relative to its size.

For example, the kind of motor used to produce vibrations in cell phones is often used for basic haptic feedback. This kind of motor is several millimeters thick, and offers no more than a few tenths of a millimeter of displacement. This means the ratio between actuator thickness and displacement is less than 0.1 (i.e. it displaces less than 1 mm for every 10 mm of thickness). An ideal tactile actuator needs to be thin enough to be comfortably worn on the skin – no more than 2-3 mm – and needs to offer up to about 2 cm of displacement. This means the ratio between actuator thickness and displacement for an ideal tactile actuator is around 10, over 100x higher than the haptic motors commonly used in cell phones!



This shows the effect of increased frame rate on moving objects in a visual display. The effect is similar for tactile displays.

red for tactile manding as the resolution and displacement requirements. Tactile displays need to be refreshed on the order of 20-30 times per second to preserve continuous sensation. As with visual displays, higher refresh rates will produce smoother motion, particularly for fast moving objects.



Our Solution: HaptX Wearable

HaptX's solution to the challenges of tactile feedback is a haptic textile capable of producing high-quality tactile feedback in a thin, flexible, wearable package. HaptX uses patented microfluidic technology to precisely control the pressure of thousands of individual actuators across the surface of the textile. These actuators can be packed in extremely high resolution arrays, offer displacements of many times their thickness, and can be updated at rates more than sufficient for tactile feedback. By varying the pressure of each actuator, we can create a virtually infinite array of rich tactile sensations. We believe this kind of tactile feedback is a must-have for fully-immersive virtual reality.

Just the Beginning

This post only just scratches the surface of haptics. Check back to learn more about haptic feedback technology. My next post will focus on the most widely used form of haptics: vibrotactile (vibration) feedback.

> *"By varying the pressure of each actuator, we can create a virtually infinite array of rich tactile sensations. We believe this kind of tactile feedback is a must-have for fully-immersive virtual reality."*

VIRTUAL REALITY ROBOTICS TECHNOLOGY NEWS CAREERS

GET OUR NEWSLETTER

REQUEST QUOTE

Share this post

Related Posts

HaptX opens the X-Lab

January 25th, 2022

HaptX announces $4m investment fro Crescent Cove Advisors to accelerate expansion

November 23rd, 2021

Corporate headquarters: 6724 185th Ave NE, Suite 300, Redmond, WA 98052