Dispersive Signal Touch Technology

Technology Profile

May, 2007

An Innovative Large-format Touch Technology from 3M

Dispersive Signal Technology, specifically developed for interactive digital signage applications, sets new large-format touch standards for fast, accurate repeatable touch response. In addition, Dispersive Signal Technology's operation is unaffected by contaminants, static objects or other touches on the touch screen. Other key characteristics of this patented technology are exceptional optics, ease of integration, and input flexibility.

Key Technology Characteristics

- Fast, accurate and repeatable touch response
- Operation unaffected by surface damage, including Scratches
- Input flexibility, accepting touch from finger, pencil, credit card, fingernail, or almost any type of stylus
- Operates with static objects or other touches on the screen
- Exceptional optical characteristics
- Scalable for sizes above 32" diameter

How Dispersive Signal Technology Works

Dispersive Signal Technology determines a "touch point" by measuring the mechanical energy (bending waves) within a substrate created by a finger or stylus touching the surface of the glass. Bending waves differ from surface waves in that they traverse through the thickness of the panel rather than the surface of the material, which provides several important advantages including enhanced palm rejection and superior scratch resistance. When the touch implement impacts the screen, bending waves are induced that radiate away from the touch location. As the wave travels outwards, the signal spreads out over time due to the phenomena of dispersion (explained below). Piezoelectric sensors positioned in the corners on the backside of the glass convert this smeared mechanical impulse into an electrical signal. The distance from each sensor determines the extent to which the signal is dispersed. Namely, the further away the "touch point" is from the sensor, the more the signal is smeared, as shown in the figure below:

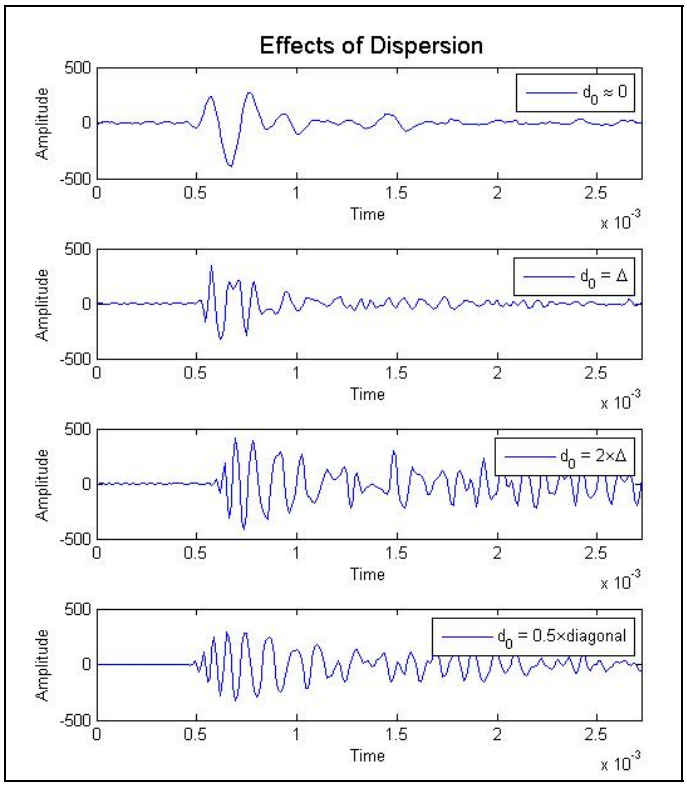


Figure 1: The top plot shows a signal arriving at the sensor with very little dispersion, where the distance between the touch location and sensor is approximately zero. As the distance from the sensor increases, the effect of dispersion becomes more noticeable.

Once these signals are properly filtered and digitized, various signal processing techniques are used to determine the touch location. Most importantly, the dispersion is corrected for by mapping between the temporal and spatial domains using prior knowledge such as the bending wave profile, glass dispersion effects, and other substrate characteristics. Once in the spatial domain, an accurate touch location is calculated using geometric intersections. To ensure that the calculated touch location is a viable solution, the alternative problem is solved and the touch impulse is reconstructed.

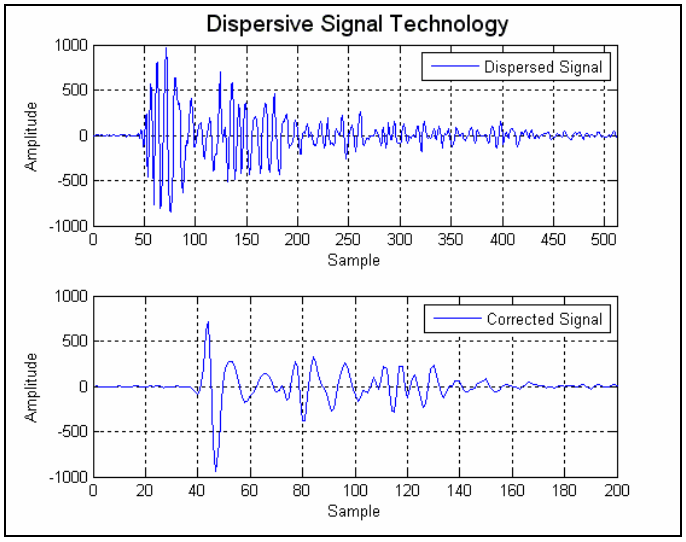


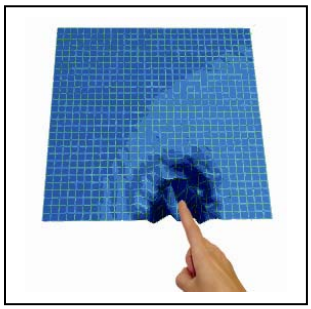
Figure 2: The top plot shows the dispersed signal received at the sensor. The bottom plot shows the reconstructed impulse once the touch location has been determined.

Dispersion Explained

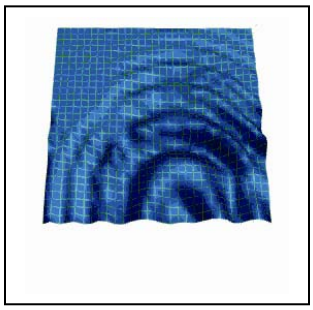
Dispersion is the phenomenon that the velocity of a bending wave propagating through solid material is dependent upon that wave's frequency. An impulse caused by a touch contact generates a number of bending waves within the substrate, all at different frequencies. Because of "dispersion", these bending waves propagate out to the edges of the glass at different speeds rather than in a unified wave front. The piezo sensors at the corners sense the high frequency waves first and the lower frequency waves second, so what the sensors ultimately receive is a wave formation that doesn't resemble original pulse. This "smearing effect" is compounded by the reflections off the internal surfaces of the glass substrate. The net result is a seemingly chaotic mass of waves all interfering with one another throughout the substrate.

3M Dispersive Signal Technology is able to interpret the source of these chaotic series of waves with its proprietary algorithms that can anticipate the "dispersion" effect and interpret the precise touch location. These algorithms, the result of an extensive 3M development effort, are the key to providing a highly accurate and sensitive solution. No other touch technology works quite this way.

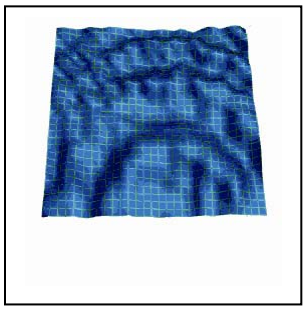
Graphic Representation of Bending Wave Effect on Glass Substrate



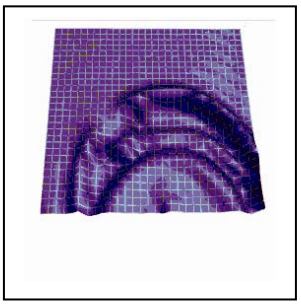
Initial Touch Contact



Progressing Dispersion with the Beginning of Reflection Effects Down



Highly Complex Dispersion Pattern with Reflections



Post-Algorithm Pattern

The Difference is "Through" the Substrate

Where other large-format touch technologies distribute an optical field, infrared beams, or acoustic waves across the front surface of the touch screen and rely on a touch to interrupt the field, Dispersive Signal Technology waits passively for a signal created by a touch contact. This fundamentally different approach means that contaminants, such as dirt, grease, and solids, can accumulate on the surface and around the edge of the screen without a significant effect on the performance of the DST touch screen. Furthermore, surface damage such as scratches or a gouge in the touch screen, will generally not affect touch performance.

Fast, Accurate, Repeatable Touch

A defining strength of Dispersive Signal Technology (DST) is the intricate, proprietary algorithms used to calculate the touch point. Due to the sophisticated and optimized dedicated controller that continuously process the touch point, DST offers the fastest and most accurate touch response among large-format touch technologies. In addition, the DST touch screen is so reliable at calculating touch points that "repeatable accurate" touch (continuous, repeated touch registering in the same location) is a key feature of this technology, offering greater than 99% touch location accuracy.

Operates with Static Objects

Dispersive Signal Technology (DST) operates with static objects on the glass surface. So, even when the user rests their other hand on the touch screen, or other users are touching the screen, or when inanimate objects such as cups, cans or keys are left on the touch screen, DST continues to respond to the user's intended touch and ignores the presence of these other objects. This unique touch capability helps avoid inadvertent touches and overcome permanent surface damage.

Exceptional Optics and Contaminant Resistance

Since the substrate is pure chemically-strengthened glass with no coatings, ridge reflectors, or optoelectronic components, Dispersive Signal Technology provides exceptional optical clarity and light transmission, and can be sealed to prevent contaminants from penetrating the display enclosure, protecting the LCD electronics and other internal components.

Input Flexibility

Since Dispersive Signal Technology measures the mechanical energy created by a touch contact, nearly any object – finger, prosthetic device, credit card – can be used to activate the touch screen.

The Innovation Continues

Dispersive Signal Technology from 3M offers large-format touch applications the unique combination of fast-accurate-repeatable touch, input flexibility, exceptional optical characteristics, and operation unaffected surface contaminants. Because of these fundamentally different touch characteristics, the opportunities for large-format touch applications will further expand to use large-format touch screen technology.

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