Brighter Signals

The Future of Touch

Technology White Paper

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Contents

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Executive Summary

Brighter Signals' approach to sensing is almost philosophical

"We are redefining how objects around us can become intelligent interfaces that help communicate what is happening in the world around them.

To know when we are sitting, sleeping or even breathing. Brighter Signal's Technology will bring a new era of sensation and perception capabilities for a range of industries."

Andrew Klein, CEO & Co-Founder

Touch is one of our most important senses. It helps us feel and can have a profound effect on our emotional reactions. Unfortunately traditional sensing technologies are not able to replicate what humans feel accurately.

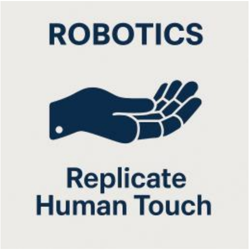
This white paper outlines the emerging need for accurate, non-invasive and context-aware sensing systems. It illustrates a growing opportunity for a new generation of high-depth signals, including sensors that are able to operate in real-time with no latency.

Sensing and signalling are not new concepts. Thus for context this paper presents a historical perspective, and introduces a new, brighter path forward - culminating in a vision for adaptable, fabric or soft sensors able to detect touch to extremely high levels of sensitivity.

These sensors not only need to produce higher quality real time data. They also need to seamlessly integrate into diverse material systems reliably and at scale.

There are already a number of active industrial applications demonstrating the power of the technology.

It will not be long before all of us are benefiting in some way. Whether it is for improved safety and comfort in vehicles, or non-intrusive vital sign monitoring of vulnerable people. Lives will depend on it.



1. The Need for More Accurate Sensing

The biggest changes in the world today are driven by capitalising on technological advancements to address societal needs. Recent advancements in quantum physics, AI and cloud computing mean we can process higher volumes of data in completely new ways. These advancements mean that productivity and offerings are being transformed across all businesses, governments and institutions.

A future driven by intelligent systems can have many definitions. Companies who unlock the power of data and new technology platforms will help drive growth in the economy. The key to realising this future is the ability to build systems that can sense, compute, learn and adjust in latency-free real time on the edge (McKinsey 2022). Flexible pressure sensors based on traditional materials are continuously advancing.

However, these advancements still fall short of meeting the demand for high quality, high sensitivity and extensive measurement capabilities (Y. Guo et al. 2024)Industry leaders in sectors from automotive, energy and medical to industrial manufacturing share a common belief that this future is going to require an evolutionary shift. Developing a method for intelligent machines and robots to learn human tactile perception is an urgent scientific problem in the field of intelligent robot research.

"Garbage in, garbage out. Your AI is only as smart as the data you feed it."

Andrew Ng, Google Brain & Coursera

"Next-gen sensing will redefine value creation in industries like healthcare and mobility."

McKinsey (2022)

"AI and intelligent systems are expected to contribute over $19.9 trillion to the global economy by 2030."

IDC (2024)

Data-Driven World

Sensors are everywhere in our lives. Modern industries, including automotive and healthcare, are increasingly reliant on real-time data to improve performance, safety, and personalization. However, existing sensing systems are limited by their binary, mechanical nature, or vision-based sensors that are not physically detecting touch.

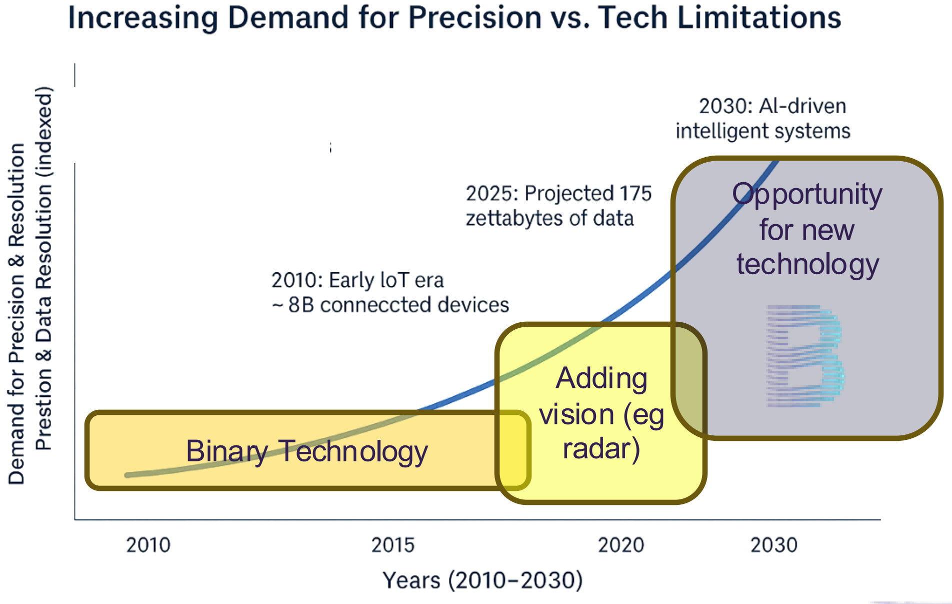
Touch is one of our most important senses. It helps us feel and can have a profound effect on our emotional reactions. Unfortunately, traditional sensing technologies are not able to replicate what humans feel accurately.

Having an accurate way to help robots and machines better perceive and adapt to complex environmental situations is needed. Richer information would enable intelligent systems to improve their autonomous decision-making and execution capabilities. (Chen, L., Zhu, Y. & Li, M. 2024)

Vision perception has already made great progress with the use of cameras, radars and lidars. However, not everyone wants to be watched by cameras all the time. Radars are less intrusive but struggle to detect people through blankets and thick jackets. Some organisations even put vision systems inside robotic hands and fingertips to help try and detect movement. These are all vision solutions, not touch solutions.

In many applications tactile perception technology might be better to use than visual perception. In order for tactile perception to be useful, it needs to be able to handle multi-channel tactile signals simultaneously: everything from pressure, bending, temperature, and breathing. The sensor must be able to move like a human can move. Not just in a binary "on-off" type mode but in significantly higher degrees of movement and sensitivity.

Flexible capacitive pressure sensors have garnered significant attention in research areas such as electronic skin, wearable devices, medical diagnosis, physical health detection, and artificial intelligence due to their advantageous characteristics, including high sensitivity, flexibility, lightness, and easy integration (Dong, C et al. 2024). Current sensor technologies often require trade-offs between fidelity, scalability and privacy. Just throwing more and more sensors into smaller and smaller areas may not be the best answer.



The other approach of just adding a camera or radar solves some of the problem but in turn adds cost, noise, complexity and lag. With rising privacy concerns, there's a growing need for sensors that can deliver precise, contextual insights *without* invasive data collection.

2. A Brief History of Sensing

Analog to Digital

Simple mechanical sensors have been around for over 50 years. You were probably taught to use a simple binary pressure sensor to create a circuit in your high school physics classroom. These types of sensors have evolved incrementally over time and include, for example, mechanical switches or pressure pads. They operate largely in binary on/off modes.

Even more advanced sensors, such as capacitive arrays, still interpret the world in a very simplified way, lacking real measurements that capture adaptability or organic response. In other words, they struggle to capture accurate information on the complexity of the real-world, especially when interfacing with dynamic, soft or non-rigid environments. Considering that people are dynamic, and soft, the conclusion can only be that these sensing methods are insufficient to cope with the emerging needs of industries such as automotive, healthcare and robotics.

Existing Touch Sensing and Tactile Sensing

Touch and tactile sensors are devices which measure the parameters of a contact between the sensor and an object. The interaction obtained is normally confined to a small defined region. In the consideration of tactile and touch sensing, the following definitions are commonly used (IEEE Sensors Journal 2021):

Touch Sensing This is the detection and measurement of a contact force at a defined point. A touch sensor can also be restricted to binary information, namely touch, or no touch.

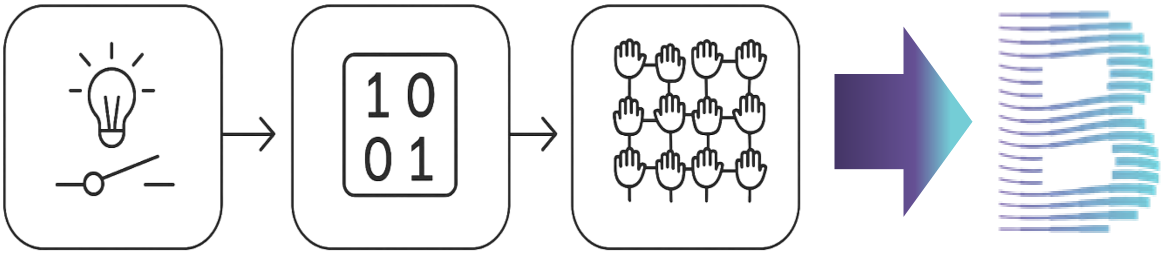
Tactile Sensing This is the detection and measurement of the spatial distribution of forces perpendicular to a predetermined sensory area, and the subsequent interpretation of the spatial information. A tactile-sensing array can be considered to be a coordinated group of touch sensors.

The current state of touch sensors such as the force sensor or the force sensing resistor (Tekscan Blog 2025) is intended to detect when there is force applied. The signal output that the computer understands is a range between an OFF state (0) to an ON state (1). Common place market sensors just use more of these sensors placed closer together, in a grid or pattern.

However, the limitation of these types of sensors is that if the sensor is bent, the computer would read a state between OFF and ON (0 to 1), thereby mistaking the potential for being unable to differentiate if it is due to a force being applied, or the sensor bending. Thus, usefulness is limited when the sensor is placed on hard machine surfaces, but severely inadequate for use in softer applications such as seats, beds and gloves.

Flexible pressure sensors that respond to normal contact force, play a pivotal role in a wide range of applications, such as health monitoring, robotic perception and artificial intelligence. With the increasing demand for specialized and high-performance pressure sensors, the key parameters of these sensors, including sensitivity, detection range, linearity, response time, and cyclic stability, etc, have become crucial factors in determining their suitability for specific applications. The characterization of these key parameters has therefore become an essential step in the overall research process (Yongbiao Wan et al 2024).

The History of Touch Sensing | The Future of Touch Sensing



Grippers and Robotics Control Systems

Robotics has the potential to replicate many human operations for different applications. About 60% of the existing robotic market is trying to create versatile robotic grippers to grasp, lift and turn multiple objects of arbitrary shape, size and weight. (Beyond Market Insights 2022). Solutions are still driven by mechanical design combined with proximity and force sensors combined with complex robot control programs. These are widely used in industrial pick-and-place applications with known object placement tasks. The disciplines of soft robotics and haptics are emerging as imitating human behaviour and projecting it into a robotics system is a big challenge (Endsley, M. R. 2017).

Appearance, dexterity and agility are all important; however, the need for safety is paramount (Alexander Dietrich et al 2012). Safety relies on the ability for the robot to react in real-time to the environment around it. Existing control systems have lag - meaning that existing robotics solutions operating near humans have to continually trade-off between steering velocity and tracking performance. In other words, in order for robots to be safe, they presently operate much more slowly than humans for basic everyday tasks.

If robots can be programmed with a better understanding of touch, and classification of what they are touching, they can be trained to operate much more safely and effectively. This could result in advantages such as faster cycle times for robotics applications or more variety in the parts the robots can work with.

3. The Sensing Opportunity

Another way to understand the limitations of existing solutions is by comparison to technology advancements in other areas. Historic methods of sensing would be similar to a television only having the ability to produce black and white images when the world is now used to High Definition.

Traditional sensors are either resistive or capacitive. They cannot do both. The do not have ability to be multi-modal. They are limited to a single mode of measurement. Thus, creating a very binary reading, rather than one that is rich, and can be interpreted in different ways. This is a clear limitation of existing, traditional technologies.

However, in addition to how they measure, what they measure is also a limitation. They can not measure what is really important to many modern applications. There are two core measurements that existing resistance sensors cannot do within a single sensor.

Sensitivity of touch - e.g., how hard is something pushing or pulling

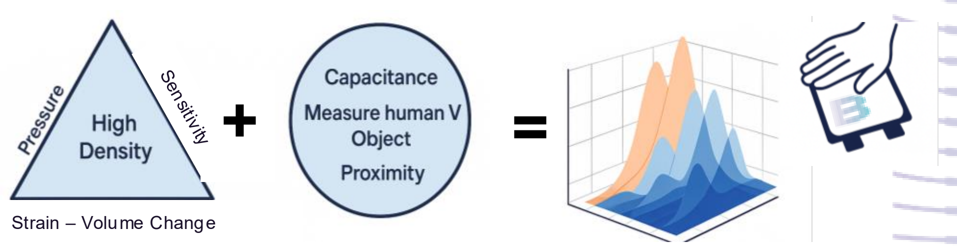
Density of touch - e.g., knowing what movements mean, understanding the strain or depression in a seat or bed

An analogy to understand the sensitivity of touch limitation is demonstrated on smartphone screens having the ability to detect when you are touching the screen, but not having the ability to detect how hard you are pressing on the screen. Existing solutions try and mitigate for this my working in multiple arrays or adding vision systems like cameras.

For conventional pressure sensors it is very hard to measure movement, strain and therefore density. The challenge of using this type of sensing in an environment where there are constant physical changes is the high potential error rate of the computer not being able to differentiate if the signal is due to sensing force, or from the sensor bending.

Using the same analogy using a smartphone screen as an example, current definitions of density of tactile measurements are defined by pixels per inch (ppi), or pixels per centimetre (ppcm or pixels/cm) (Wikipedia 2025). Using the iPhone 16, with 460 ppi density, to measure the potential of depth from a fingertip pressing hard across 1 inch (2.54 cm) of the screen would require 460 sensors. In trying to solve the problem this way the sensor introduces new problems of cost, noise and lag.

Monitoring and classifying occupants in a single sensor has not been possible until now. High-depth tactile sensing means being able to measure both sensitivity and density of touch. It means being able to deliver rich, continual, contextual data. Historical solutions are already at their limits and not able to deliver. A new evolution is needed.



""Brighter Signals is pioneering a new class of touch and tactile sensing with a patented technology that measures high-depth signals, which is the ability to measure both sensitivity and density of touch. Side by side comparison of the existing method versus Brighter Signals is staggering. Measuring surface area density today might require 460 sensors in 1 inch, with our advanced technology only a single sensor is required. "

Edward Shin, CTO & Co-Founder

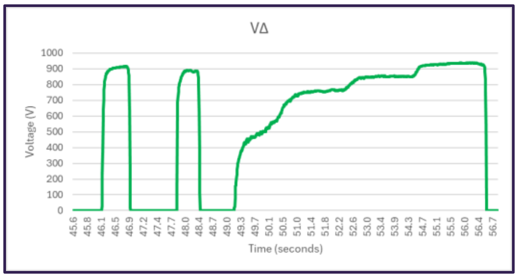
Paradigm Shift in Sensing to High-Depth Signals

Brighter Signal's Technology captures a much higher-depth of data signal compared to traditional sensors transmitting an analogue data stream. The rate of sampling can be varied based on application. For example, we performed our prolonged applied pressure tests, resulting in measuring a 10ms response time, at 9600 Baud Rate, 88Hz, 10-bit ADC.

Below are two (2) graphs demonstrating the same sensor using raw signals of different measurement methods (ΔV left graph and Capacitance right graph).

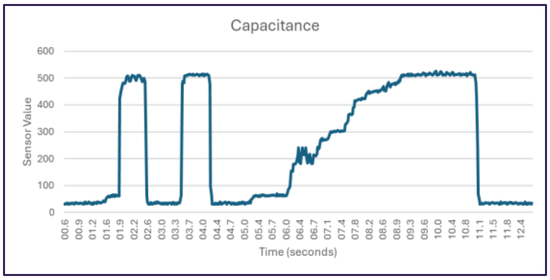
Direct ΔV Measurement with 1KΩ pull-down resistor

Applied force followed with increasing pressure.



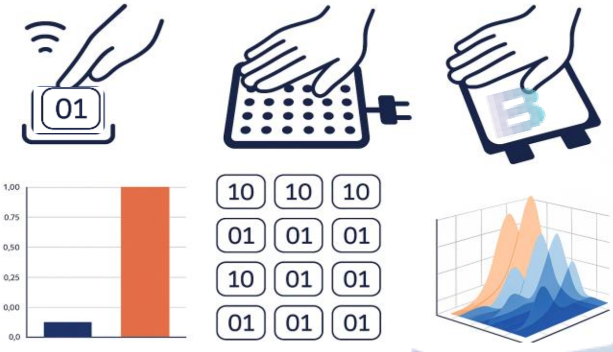
Capacitance (t∝RC) Measurement with 1MΩ resistor

Proximity and contact with sensor.



Using the earlier television analogy, this would be similar to our technology having the capability to produce images with a wide range of colours in High Definition rather than simply black or white.

The accuracy, sensitivity and density of touch are already an evolutionary leap. Having data that is richer, continual, contextual and lower cost is already enough to pioneer multiple new opportunities for commercial applications.



The technology can be used to mimic how nature works - how human skin senses touch and interprets those signals. This tactile perception technology will open up new possibilities to provide high-depth signal data and a means of interpreting that data so that intelligent machines and robots can begin interacting and perceiving the environment around them in completely new ways.

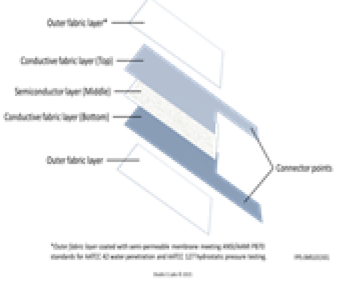
4. Brighter Signals' Technology & New Paradigm Shift

The fully fabric sensor is novel in its function and construction. The innovative semi-conductive layer, sandwiched between two conductive layers, is a new patented method of multimodal measurement. It allows partially dielectric separation for Voltage change (VΔ) reading, and Capacitance (C) measurement from the same sensor

The semi-conductive layer provides sensor-level filtering for real-time measurements capable in Voltage differential and/or capacitance. Resulting in sensing proximity, contact, force and dynamic pressure density.

The natural softness and flexibility of the fabric makes the sensor ideal for objects that people interact with like chairs, bedding, and clothing. In industrial applications such as soft robotics where tactile grippers and mechanical hands are constantly changing form due to mechanical bending.

- Our sensor fabrication is material-agnostic and scalable. Standard sensors use stainless steel in their construction, however higher resistive materials are available on request and with consultation.
- It introduces high-depth signals that can measure when flat or bent, when placed on hard or soft surfaces. The sensors work just as well when placed on soft seats as they do on rigid surfaces.
- It integrates seamlessly into fabrics, foams, plastics, and composite materials to allow a higher dimensionality of sensing.
- Due to the independent layer the costs to manufacture are lower than equivalent rigid materials.
- The same sensor can be used for capacitive and/or resistive methods, uniquely allowing developers to choose the best method(s) for their application



In addition to patenting the underlying concept, Brighter Signals has developed the knowledge and know-how around manufacturing and supplying at scale. The technology is modular and can be applied to different industries depending on the supply chain requirements and variability of SKUs.

The core sensors can be supplied as fabrics. However, Brighter Signals can work with different customers to build the solutions into plastics, foams and rubbers. Most sensors are being integrated into existing workflows and assembly lines. Therefore, they can be supplied using a range of standard interfaces and mechanical connectors. Different applications have different supply chains and value chains.

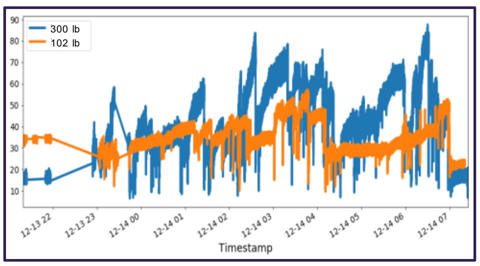
5. Industries & Use Cases

The Brighter Signals' technology can be translated into many applications.

The technology has already been extensively tested and applied to many industrial applications. Some work has been done under confidentiality agreements and can not be shared. However here are a few use cases that help showcase the strength of the technology and how it can be used to develop new applications.

Healthcare – Clinical Study (Nicholson, Lim and Shim 2018)

Intelligent bedsheet detects respiratory patterns.
Detect heart rate, respiratory rate and respiratory effect.



Sensing Reading
Sensors measure weight differences of human participants. (weighing 46kg and 136kg lying on sensor array)

Automotive - Audi Innovation Award Winner

Beating the best-in-class for passenger occupancy detection
Can be used measure occupancy classification, movement and position
Brighter Signal partner for manufacture with an Automotive Approved supply chain partner

Prize winner x 2
Mobility Partner Prize
Audi AG Top Prize

Location of incumbent sensor solutions

7. Why us, Why now?

Brighter Signals is led by a multidisciplinary team from three countries, united by a shared belief of making electronics more human. This is the right technology, in the right place at the right time. With the best team in place to execute and deliver.

> "We are pioneering a new wave in the way machines sense the world. We believe that within the next decade we will see our sensors being adopted and used in every car, factory and hospital."
>
> **Christine Fraser COO & CO-Founder**

- Right Moment: Trends in AI, autonomy, remote care, and ambient computing demand smarter, subtler sensing requiring higher quality unique data. There is an opportunity for a leading technology to replicate touch in the way that Cameras, Lidar and Radar are leading the way to replicate sight/vision.

  Different industries are trying to overcome some of their inherent weaknesses and looking to emerging technologies for new solutions. Dexterity and tactile sensing have been described as the last frontiers to be overcome before robots can be adopted at scale. While consumers and regulation are pushing for safer systems in cars and hospitals.

  Macro economics are driving supply chains to be more energy conscious and consider the entire CO_2 footprint. Products are under pressure to become more sustainable, lightweight and recyclable.

  New technologies and solutions will emerge to close these gaps..

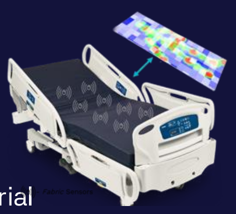
- Right Technology: We are the only High-depth signal tactile perception technology available today. Our granted patent, patents pending and commercial know-how make us pioneers in this field. Our approach covers multilayer sensing structures and materials, configurations, and diverse industry applications. Designed with manufacturability and cross-material deployment in mind with a globally mature textile industry for flexible production of materials and components. We use age old manufacturing techniques to now make deep tech textiles.

- Right Team: A great dedicated team with over 60 years of relevant technology and business experience. We are building a platform that will help industries move from binary inputs to *brighter signals*.

Brighter Signals

The Future of Touch

- Patent Granted
- US10386224B2
- Link to Patent



Clinical Trial

Nicholson, Lim and Shim 2018 " *Intelligent bed sheet detects respiratory patters"* Sage journals, Volume 62, Issue 1 Sept 2018
Link to Clinical Trial Publication

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References

•Beyond Market Insights (November 2022). Robotics Market Overview. https://beyondmarketinsights. com/report/robotics-market/

•Chen, L., Zhu, Y. & Li, M. Tactile-GAT: tactile graph attention networks for robot tactile perception classification. Sci Rep 14, 27543 (2024). https://doi.org/10.1038/s41598-024-78764-x , https://www.nature.com/articles/s41598-024-78764-x

•Dong, C., Bai, Y., Zou, J., Cheng, J., An, Y., Zhang, Z., … Li, N. (2024). Flexible capacitive pressure sensor: material, structure, fabrication and application. Nondestructive Testing and Evaluation, 39(7), 1749–1790. Link

•Endsley, M. R. (2017). From here to autonomy: lessons learned from human–automation research. Human factors, 59(1), 5-27.

•IDC (2024): *"AI and intelligent systems are expected to contribute over $19.9 trillion to the global economy by 2030." – Link*

•IEEE Sensors Journal (2021): *"Binary tactile sensing limits contextual awareness in robotics and wearables." - Can not find this will fins alternative* https://www.sensorprod.com/wp-content/uploads/2023/09/Tactile-Sensing.pdf

•McKinsey (2022): "Next-gen sensing will redefine value creation in industries like healthcare and mobility."mckinsey-tech-trends-outlook-2022-full-report.pdf

•Reactive Whole Body Control - by Alexander Dietrich et al Vol. 19, No. 2 IEEE RAS Robotics and Automation Journal - Manipulate and Imitate: The "Uncanny Valley" of Humanoids

•Strickland, Eliza. (2022). Andrew Ng, AI Minimalist: The Machine-Learning Pioneer Says Small is the New Big. IEEE Spectrum. 59. 22-50. 10.1109/MSPEC.2022.9754503.

•Tekscan Blog 2025 https://www.tekscan.com/blog/flexiforce/how-does-force-sensing-resistor-fsr-work

•Todays Medical Website (2025) - 13 characteristics of an intelligent systems future – Link

•Wikipedia (2025) - Pixel Density https://en.wikipedia.org/wiki/Pixel_density

•Y. Guo *et al.*, "Status, Applications, and Challenges of Flexible Pressure Sensors Based on 2-D Materials: A Review," in *IEEE Sensors Journal*, vol. 24, no. 7, pp. 9251-9277, 1 April, 2024, doi: 10.1109/JSEN.2024.3359279

• Yongbiao Wan et al 2024 J. Phys. D: Appl. Phys. 57 093002