DDS

DIRECT-TO-DIGITAL SENSING

May 2022

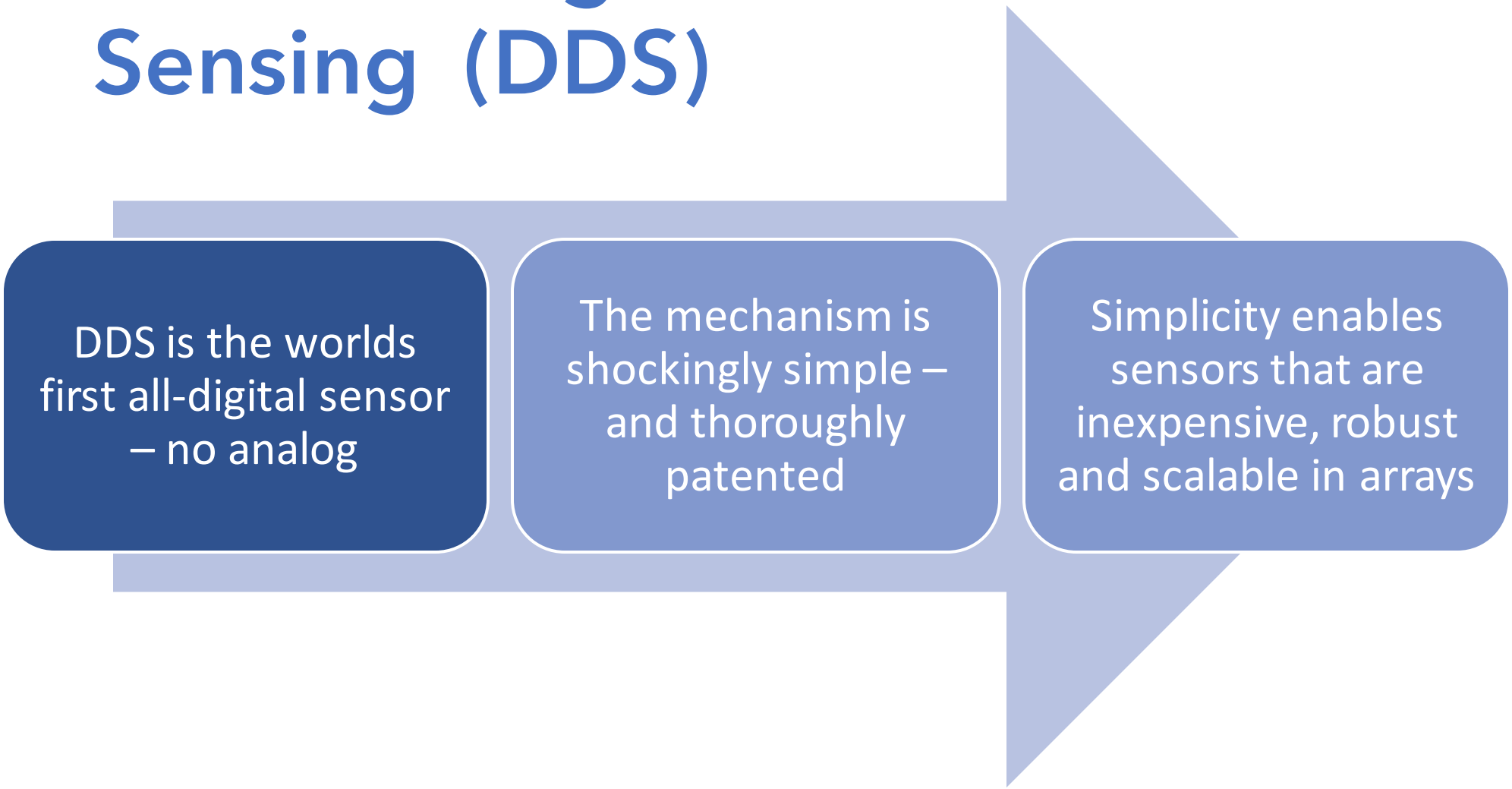
INVENTIONSHARE®

Sensors are in everything

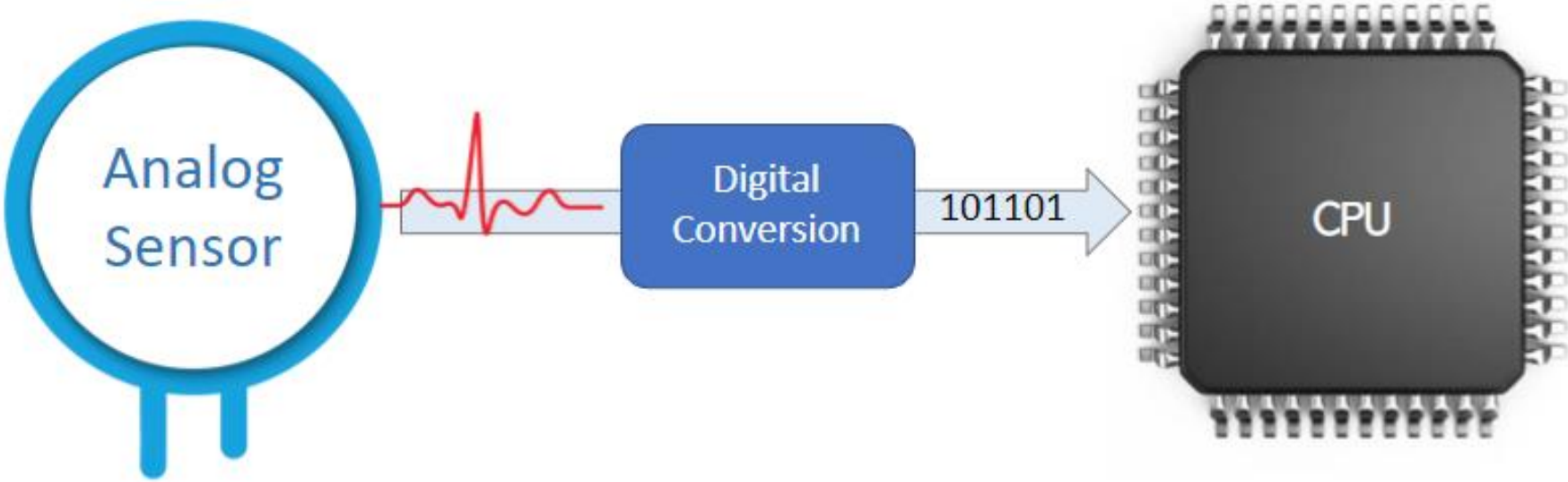
Appliances, vehicles, sports equipment and even watch bands.

There's no end in sight!

Direct to Digital Sensing (DDS)

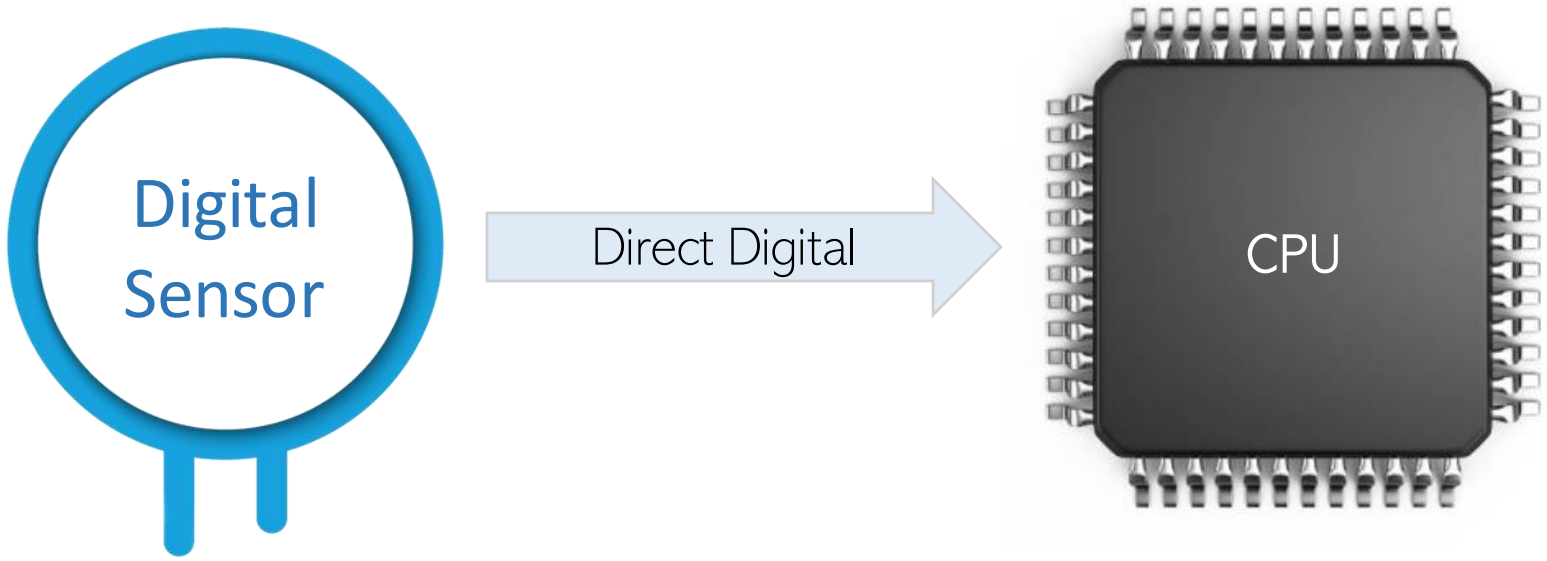


Most other sensors are analog



They capture an analog electrical signal that is converted to digital for CPU analysis and action.

DDS is natively digital



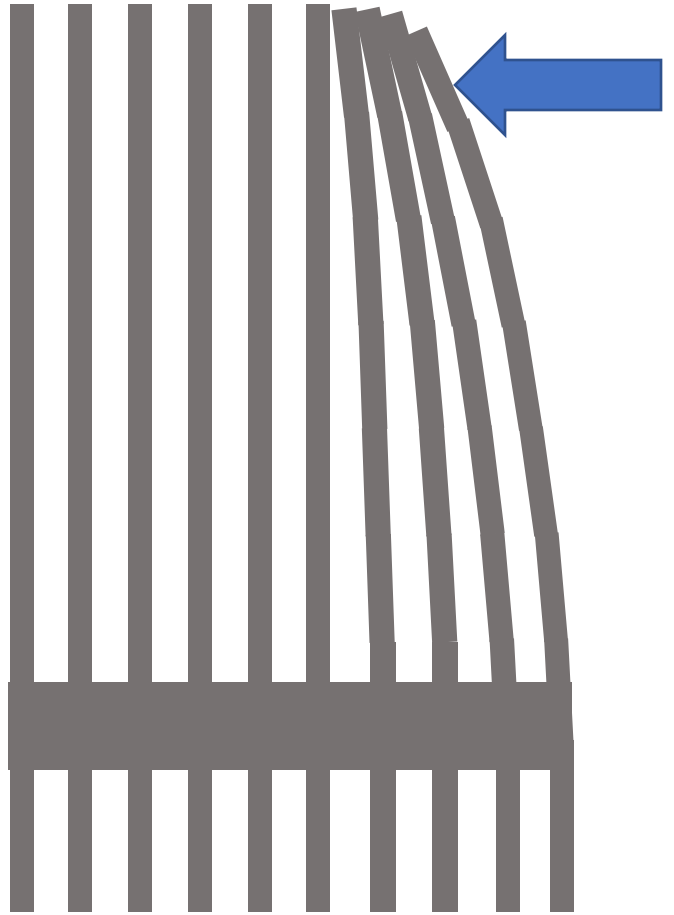
No analog conversion required!

Advantages of Direct-to-Digital

- Extreme speed – instantly read direct digital
- Simple cost-efficient design
- Sensor arrays become practical
- Near-zero power consumption

A simple principle

- Displacement is measured using a series of deformable electrical contacts.
- A CPU can scan which contacts are pressed together without requiring active circuitry.
- The device is inherently digital - a contact is either open or closed: 1 or zero



What can DDS measure?

- The basic DDS mechanism measures displacement
- That in turn can measure strain
- With the addition of a proof mass DDS can measure force, acceleration and vibration

Application Examples

MACHINERY & INFRASTRUCTURE

CONSUMER GOODS

TRANSPORTATION & VEHICLES

Foot Pressure Monitor

Orthotics

- Insole with embedded DDS array
- Multiple pressure levels per sensor
- Li-ion battery
- Fast sample recording
- Wear during activities (e.g. running)
- Bluetooth data extraction
- Smartphone/PC analytics

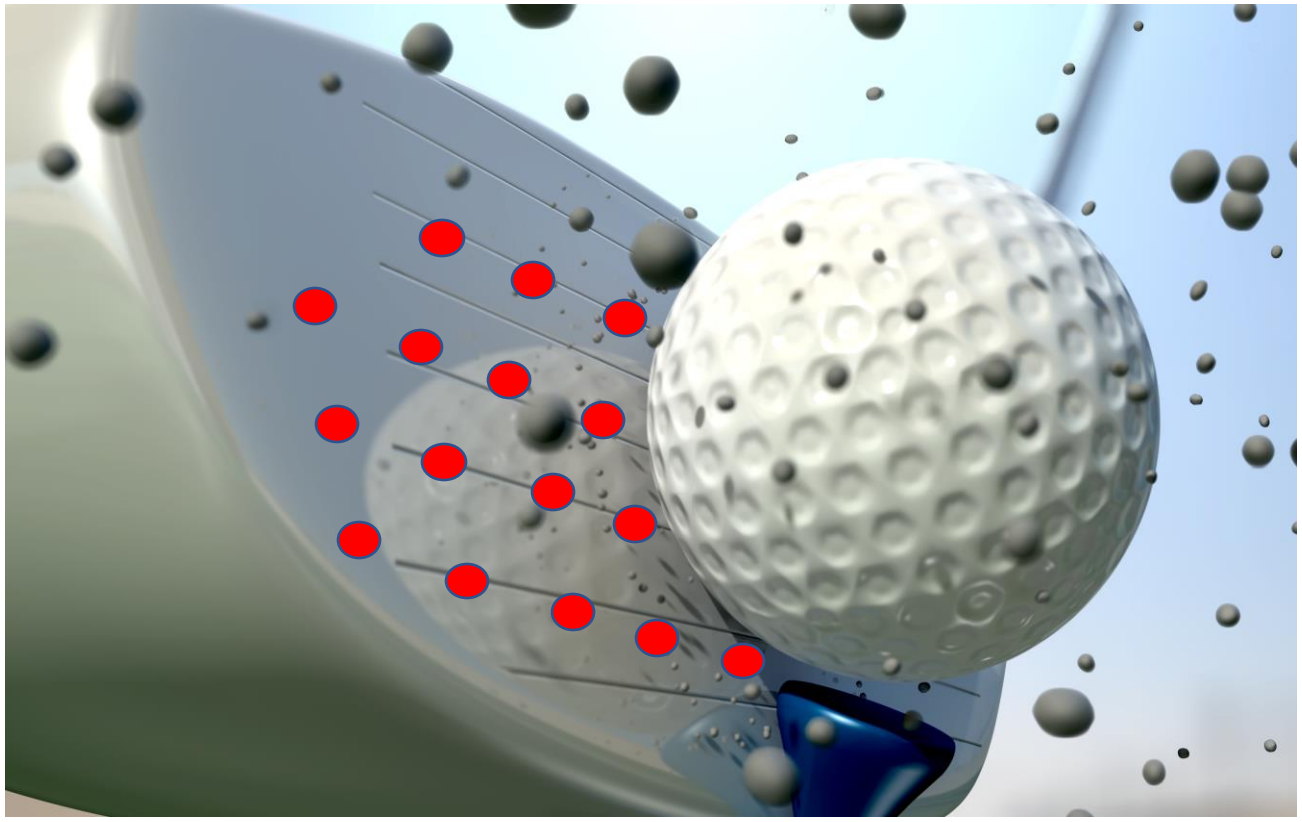
DDS Application example

Golf Club Impact Monitor

Golf swing analytics

- Sensors embedded in the club head
- Record impact signature for each shot
- Report deviation from "sweet spot"
- Li-ion battery
- Bluetooth data extraction
- Smartphone analytics for each shot

DDS Application example



Shock Monitor for Packages

Shipping services

DDS Application example

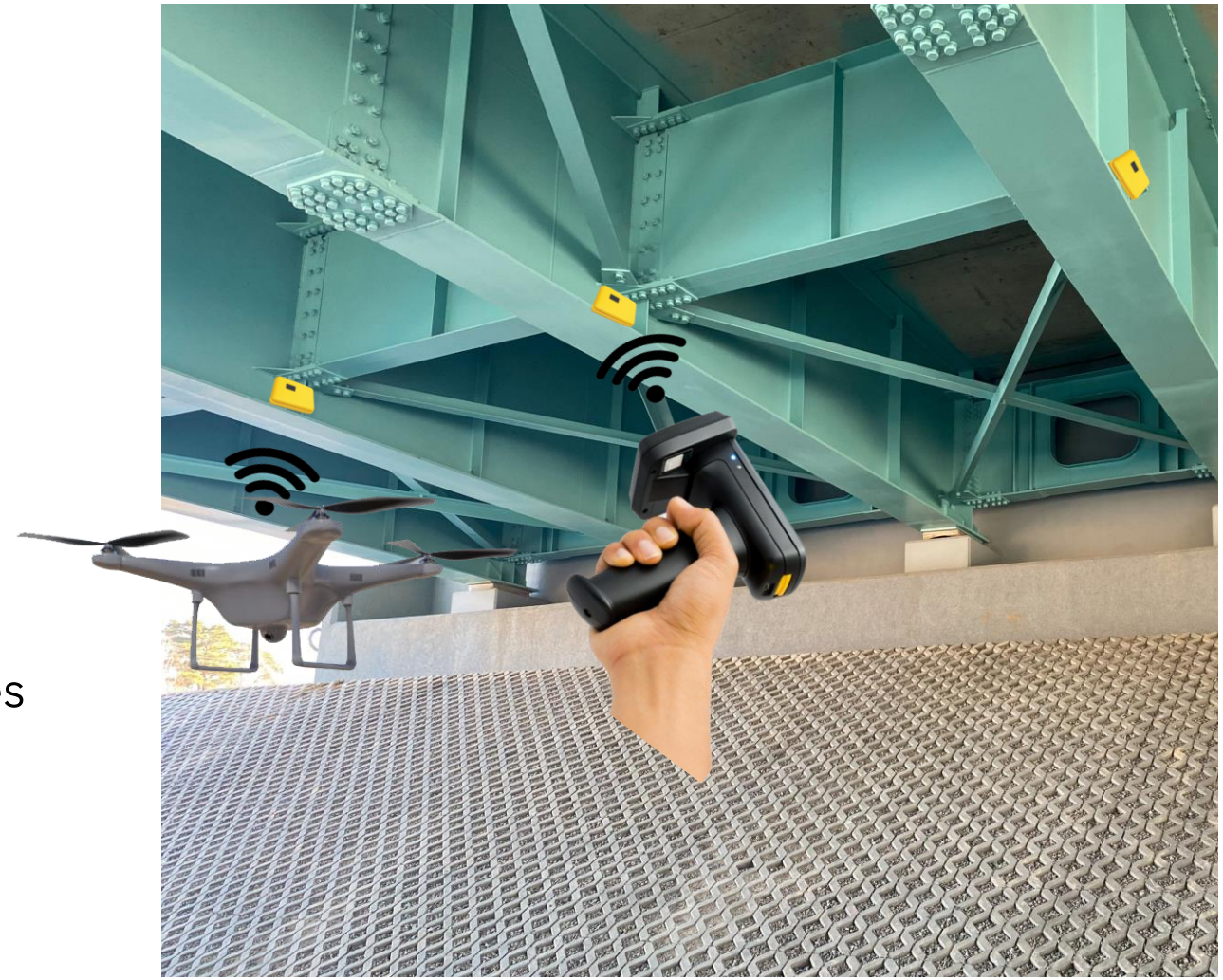
- Stick-on shock-sensing label
- Contains DDS integrated with RFID
- RFID reports maximum recorded shock
- Optional MCU can report shock timeline

Structural Monitoring

Sensors at critical locations

- Zero-power: DDS + passive RFID
- Unlimited lifetime operation
- Robust hermetically sealed packaging
- Attach to new and old structures
- Read sensors with handheld readers or drones
- Detect shifting, sagging, overloading

DDS Application example



Automobile Shock & Vibration

DDS Application example

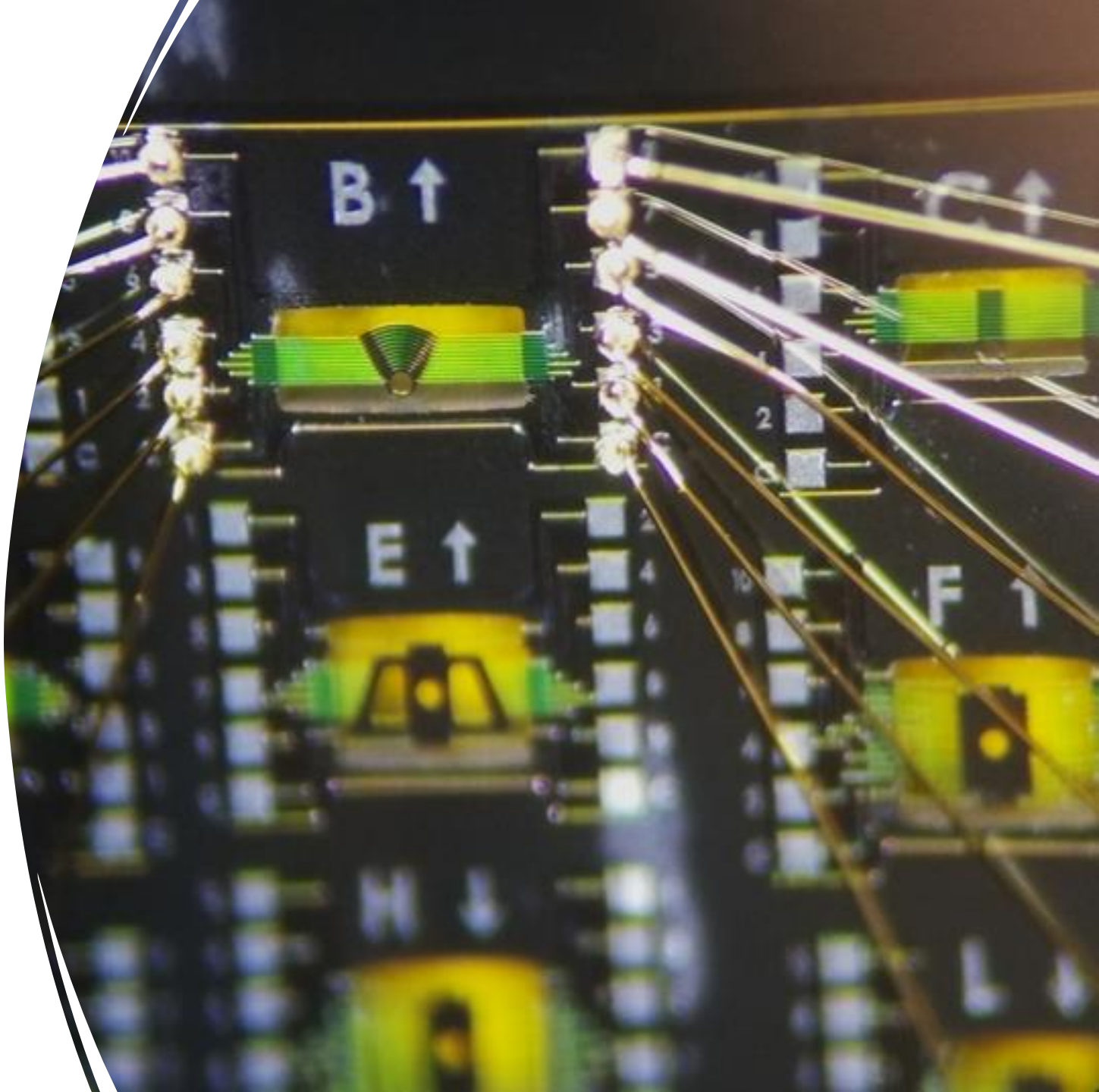
Sensors attach near wheels

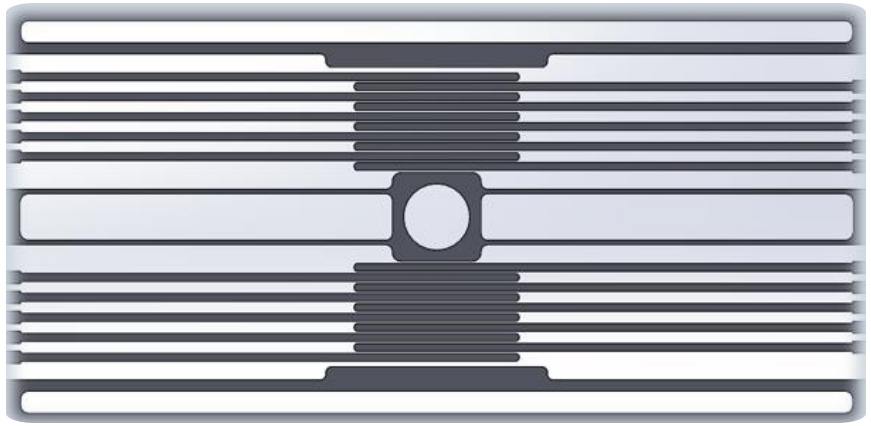
- Robust hermetically sealed packaging
- Integrated battery for life of vehicle
- Integrated in new vehicles or attached as aftermarket
- Detect vibration imbalances, out of spec conditions
- Record shock event timeline
- Bluetooth or RFID data extraction

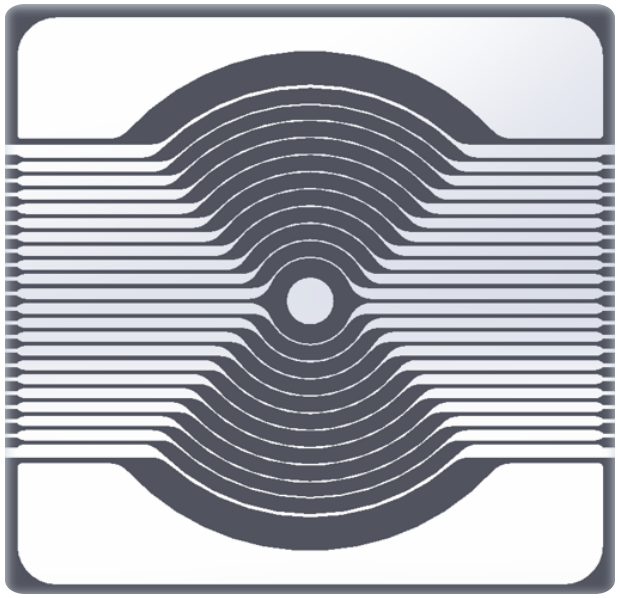
MEMS

Micro-miniature DDS prototypes have been tested using MEMS.

(MicroElectroMechanical Systems)







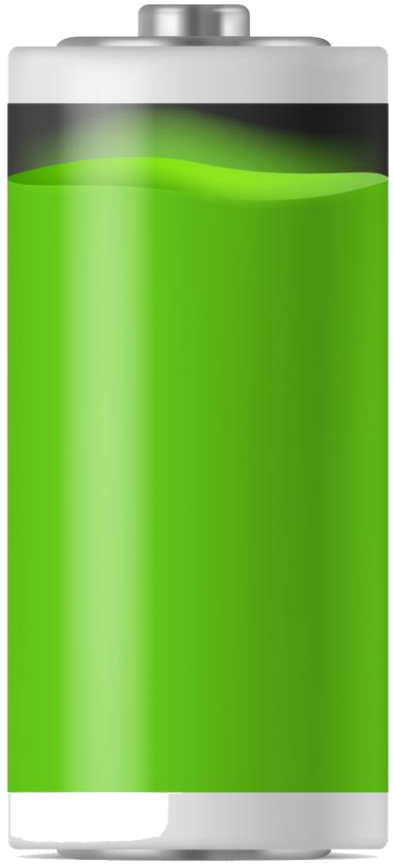
Calibrated for life

- The dimensions and geometry of the deformable contacts determine the resolution and dynamic range of the digital output.

- The DDS structure can be configured and pre-calibrated during manufacturing for different applications.

Low Power

- DDS consumes almost zero power
- MCU interface requires only passive components
- DDS can generate event-based wakeup for MCUs
- Intelligent sensors can run for decades on battery



Reliability

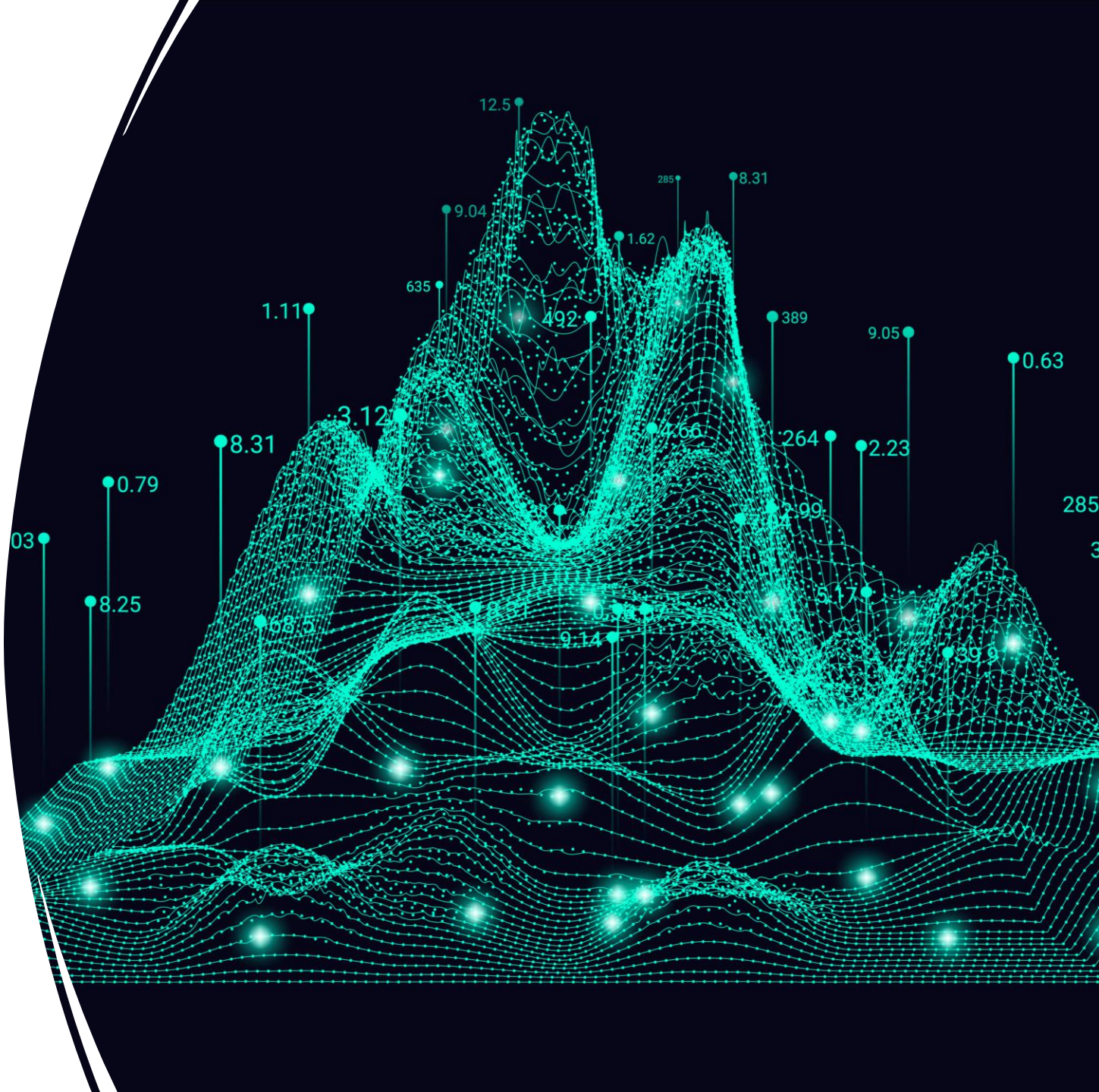
- DDS has high expected MTBF
- Long life without servicing
- Highly immune to:
  - Temperature & Humidity
  - Electromagnetic radiation
  - Vibration

Membranes

- The DDS principle can be implemented by layers of printed-conductor membranes .
- Pressure on the membranes causes them to deflect past separators and make electrical contact with adjacent membranes.
- This opens the door to constructing extremely large sensor arrays.

Point Clouds

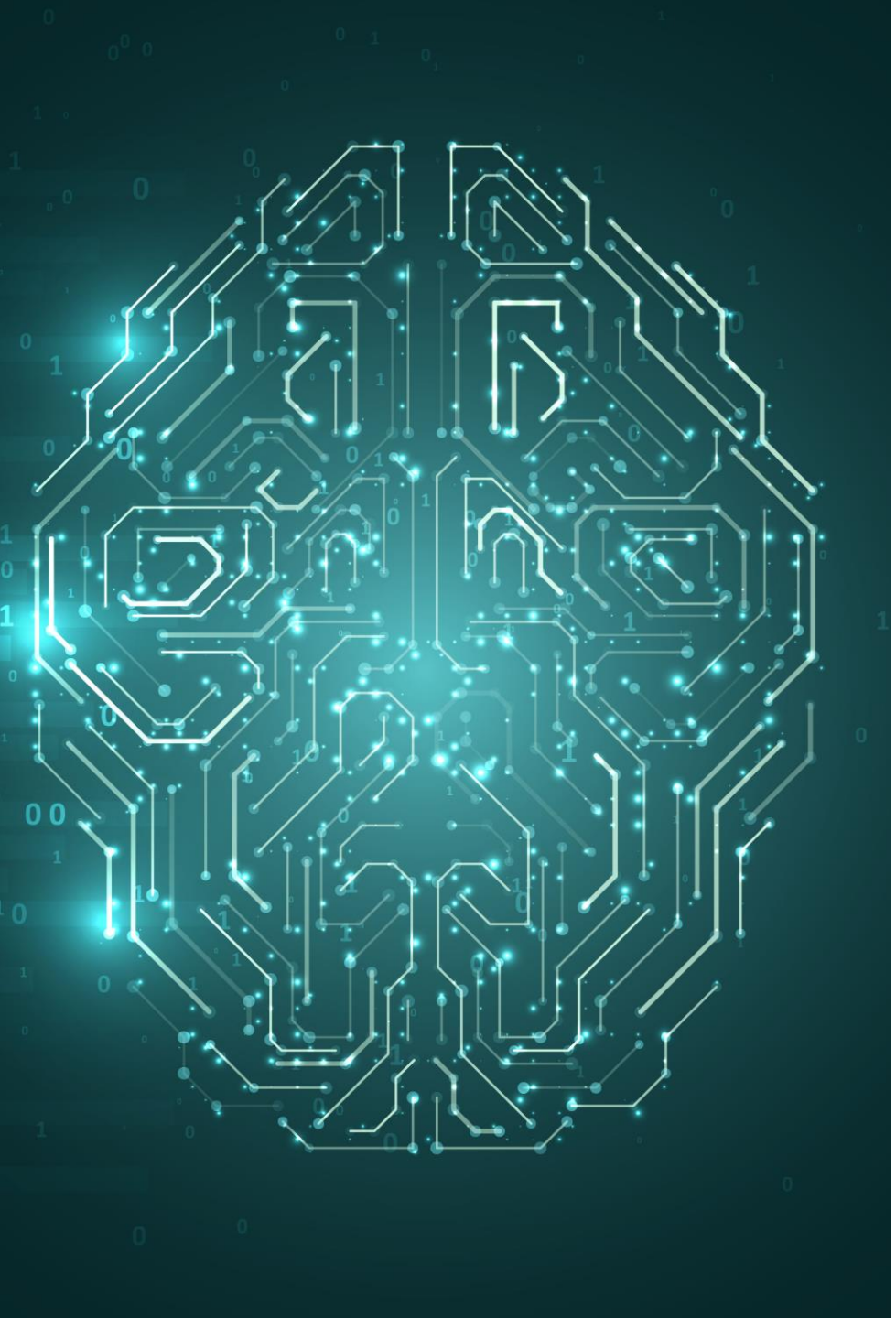
DDS pressure sensor arrays producing detailed point clouds that are real-time pressure images across a wide range of surfaces, sizes and sensor densities.



Application example

Metaverse

- The Metaverse will require new sensing technologies to interface with the real world.
- DDS is ideally suited for creating high resolution touch and pressure arrays.
- Imagine pressure-sensitive footwear and floor mats providing a layer of sensory input to Metaverse environments.



Artificial Intelligence

Combined with artificial intelligence, high-resolution DDS pressure sensor arrays can pave the way for new safety, automation and robotics applications.

DDS

DIRECT-TO-DIGITAL SENSING

INVENTIONSHARE®