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# Poster

## XDense: A Dense Grid Sensor Network for Distributed Feature Extraction

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## Abstract

# XDense: A Dense Grid Sensor Network for Distributed Feature Extraction

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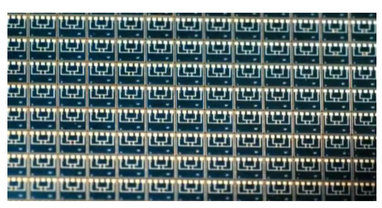
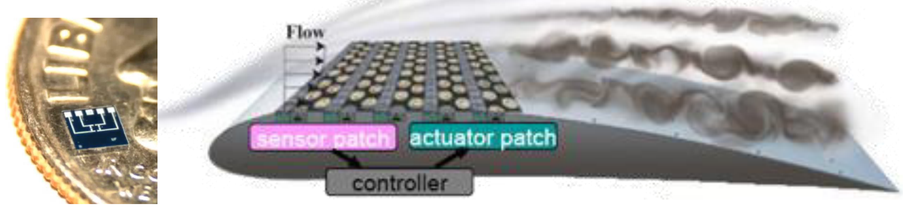
## Motivation

Development of a sensor network architecture tailored for high sampling rate applications and high density of sensor node deployments

### Application example: Active Flow Control (AFC)



Hot wire shear stress sensor from FCAAP[2]




WICAS [1]

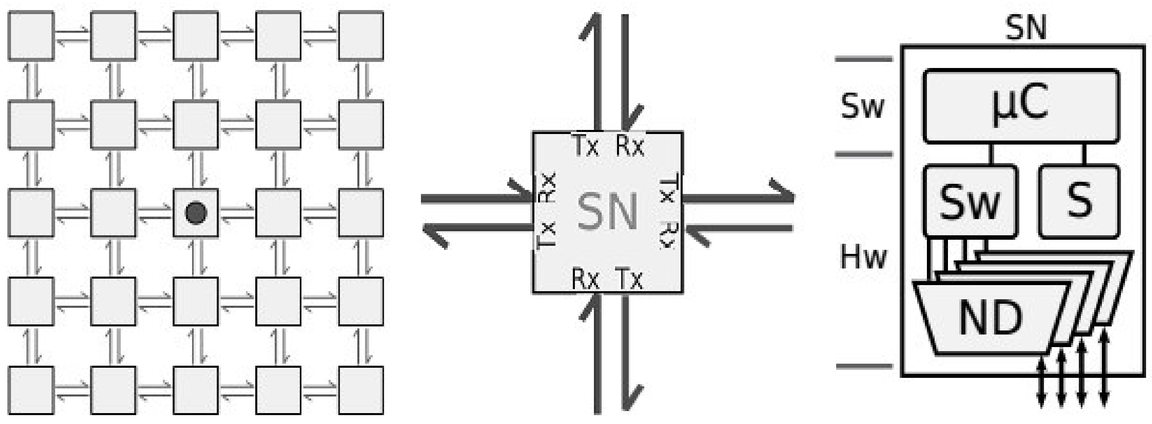
- Scales of **100 µm** for the sensor size and its interspaccing;
- Sampling rates of **100 kHz** or more
- Large number of sensors required for capturing the phenomena.

## Objectives and System Architecture

### Objectives

- Investigate architectural and communication issues for a large-scale dense sensor network, addressing issues like network topology, medium access control, routing and in-network data processing.

- Design of distributed processing strategies for detecting events with low latency which is essential to meet the requirements of RT control systems.




- Mesh grid sensor network: Local data exchange and processing enables complex feature detection, and reporting of pre-processed data;

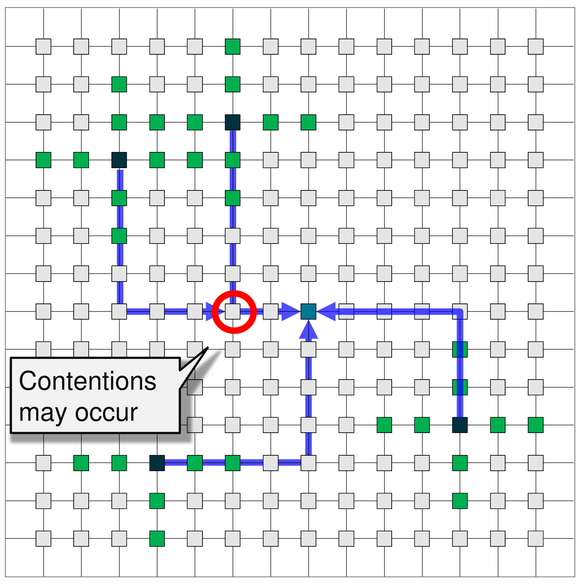
- The growth of the network does not impact significantly on the overall latency. Can scale up to any size, limited only by the minimum of one sink on each node's address space

### 3 state principle of operation:

**1st Network Discovery**
Each node discovers its neighborhors and the closest path to the sink(s)

**2nd Event Monitoring**
Communicate sensed values with their n-hops. (Ex: in figure n = 2)

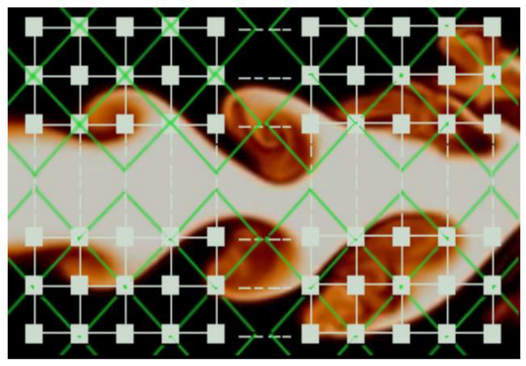
**3rd Event Announcement**
Data is sent to the sink by the nodes who detected any feature.




## Building XDense

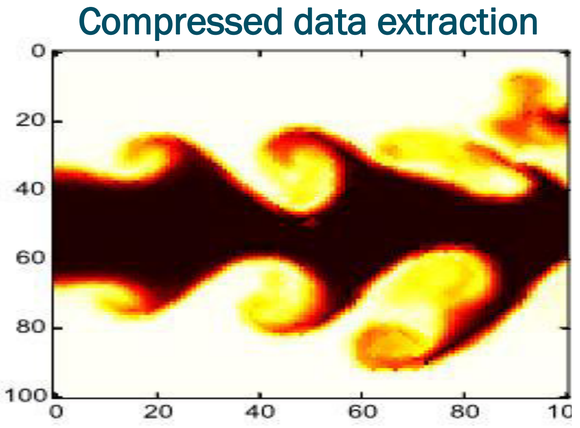
### Simulation Results

A network of 101x101 nodes and one sink is superimposed in a fluid dynamic scenario.



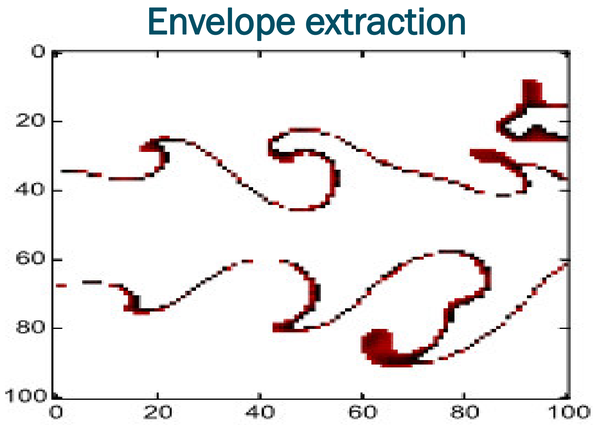
A planar free air jet from a CFD is utilized as the input of our sensor nodes. We peform:

**Compressed data extraction**




Takes 20% of the total time required to read all the nodes

**Envelope extraction**




Takes 8% of the total time required to read all the nodes

### Implemention with COTS

We use Atmel ATSAM4N8A uC (ARM Cortex M4@100MHz)

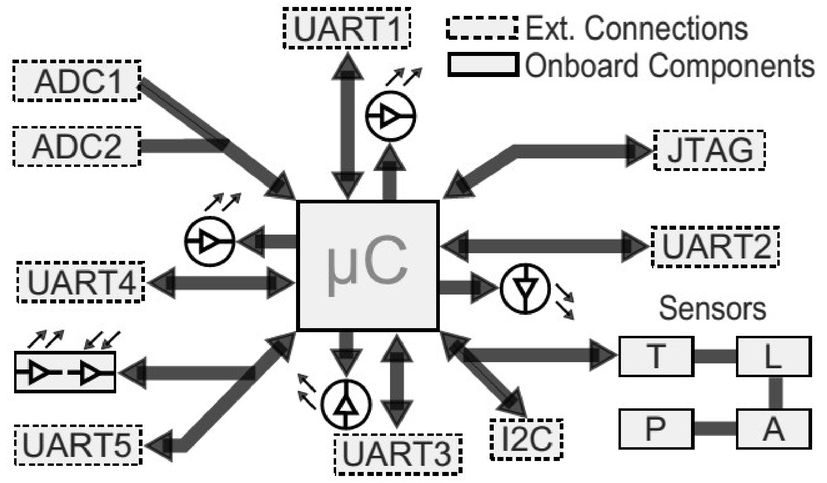
It has 5 UARTS and 23 DMA channels in a 48 pins package

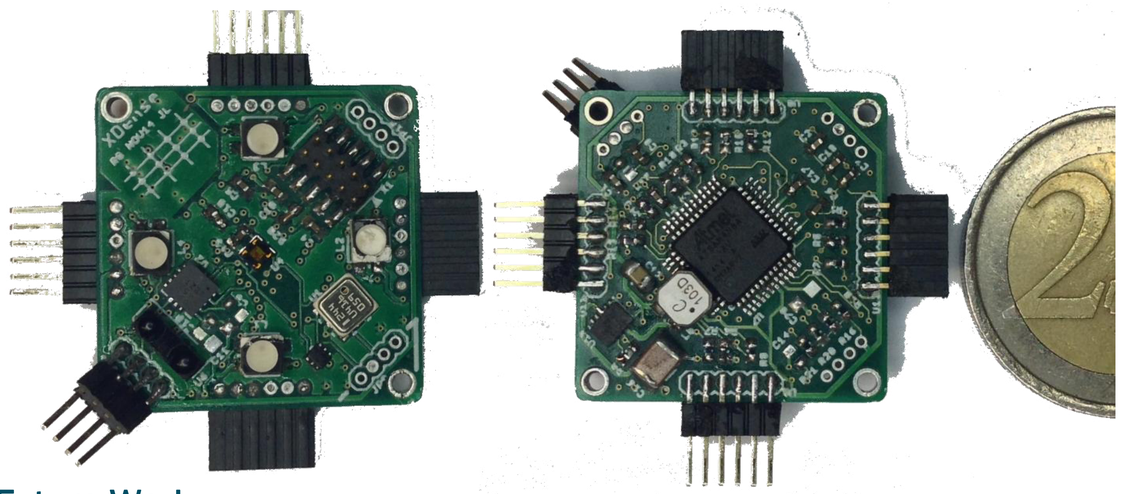
For sensing:

- Luminosity
- Accelerometer
- Temperature
- Pressure

For acting:

- 4 RGD LEDs



### Future Work

Examine the significance and efficacy of this approach by exploring aspects like routing, flow control and distributed data processing and aggregation.

## References

[1] Wireless Interconnectivity and Control of Active Systems Website (WICAS), http://www.shef.ac.uk/systemsutc/projects/wicas
[2] FCAAP. Florida Center for Advanced Aero-Propulsion

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