TEMPOSENSE

Harnessing the Power of AI for Smart Sensing

CVPR 2025 – June 12, 2025

A New Approach to Neuromorphic Sensing

Davide Migliore – Tempo Sense

Company Overview

We are a Team of US-Based Experts in Sensing, Compute, and AI

- Founded in **June 2024** in collaboration with Broadhaven Ventures
- Groundbreaking, **US-based IP and US-based company**
- **A world-class research and science team** with decades of experience in event sensing and compute
- **Fully integrated solution** with sensors, compute, and software, offering out-the-box and customizable options

World-Class Research and Science Team Collaboration

We are a Team of Experts in Sensing, Compute, AI, and Business

Research & Engineering Advisors

Ryad Benosman –
- Formerly Director of Research at Meta
- Co-founder of Prophesee (event-based cameras) and GrAI Matter Labs (neuromorphic AI processors)

Kostas Daniilidis –
- Ruth Yalom Stone Professor of Computer and Information Science at the University of Pennsylvania since 1998.
- Professor at Archimedes, Athena Research Center, Greece.

Sio-Hoi Ieng –
- Co-Founder of Prophesee and GrAI Matter Labs
- PhD in Computer Vision, University Pierre et Marie Curie
- Associate professor, Université Pierre et Marie Curie

Cornelia Fermüller –
- Research scientist UMIACS at the University of Maryland, College Park
- Co-founder of the Autonomy Cognition and Robotics (ARC) Lab and co-leads the Perception and Robotics Group at UMD.

Rajkumar Kubendran –
- Assistant Professor at University of Pittsburgh
- PhD in Electrical and Computer Engineering, Univ. of California, San Diego
- Formerly Qualcomm, Intel, IMEC Belgium and MaxLinear

Bernabé Linares-Barranco –
- Director of the Instituto de Microelectrónica de Sevilla
- Stanford top 2% most world-wide cited scientist in Electrical and Electronic Engineering

Re-Imagining Neuromorphic Computer Vision Pipeline

Our technology enables a new generation of smart devices to see better, faster, and smarter than ever before

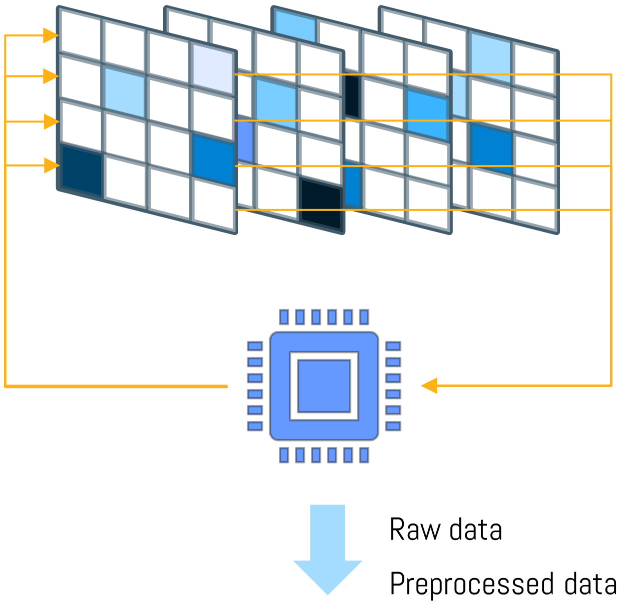
Neuromorphic Sensor

- ✓ Next-gen sensor tech inspired by the human eye
- ✓ Efficiently captures only necessary visual data by ingesting only "events" (changes in the scene)

+

Integrated Processing on Chip

- ✓ Dedicated hardware processor for event data
- ✓ AI-enabled software suite for smart processing and greater performance



Raw data

Preprocessed data

Tensor, Event2Vec,...

Tempo Sense Solution: Take Control of the Read-Out

Pixel on demand architecture:

- Innovative IPs enabling full application control over sensor readout
- Seamless synergy between sensor and processing
- Precise readout timing: 100 μs to read the full image plane (200 ns to read two rows)
- Miniaturization-friendly pixel design for future application in wearable devices
- Large fill factor to enhance low-light sensitivity
- Complete control of the event stream to simplify the integration with embedded devices

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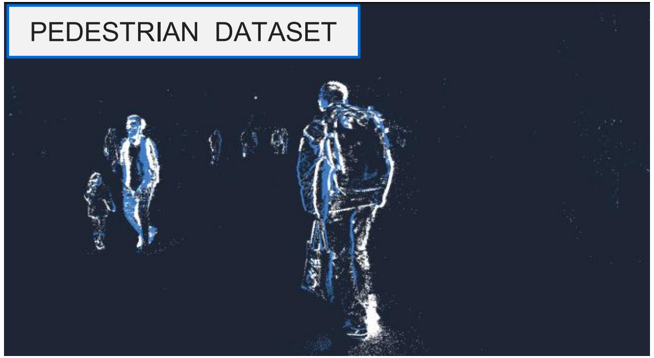
Traditional Neuromorphic Sensors

The pixel is typically at the center of sensing



https://docs.prophesee.ai/stable/datasets.html

Characteristics:

- 1 µs timestamp resolution, but latency min 100 µs
- Up to 10,000 fps read-out
- Different stream data formats:
  - Traditional x,y,t,p
    - 14 bit for coordinate
    - 32 for timestamp
    - **64 bit / event**
  - Time encoded (EVT 2.0)
    - 11 bit for coordinate
    - 34 bit for timestamp
    - **~32 bit / event**
  - Data encoded (EVT 3.0)
    - Data vectorization in 16 bit
    - 11 bit for coordinate
    - 24 bit for timestamp
    - **~ 44 bit / event (average on pedestrian dataset)**

Problem: The pixel has control of the readout.

1. Data rate out of control (PSEE ERC).
2. Embedded devices interface is challenging, as we do not know the data packets size.

Why “Take control of the read-out”?

Simplify the interface and optimize data transmission

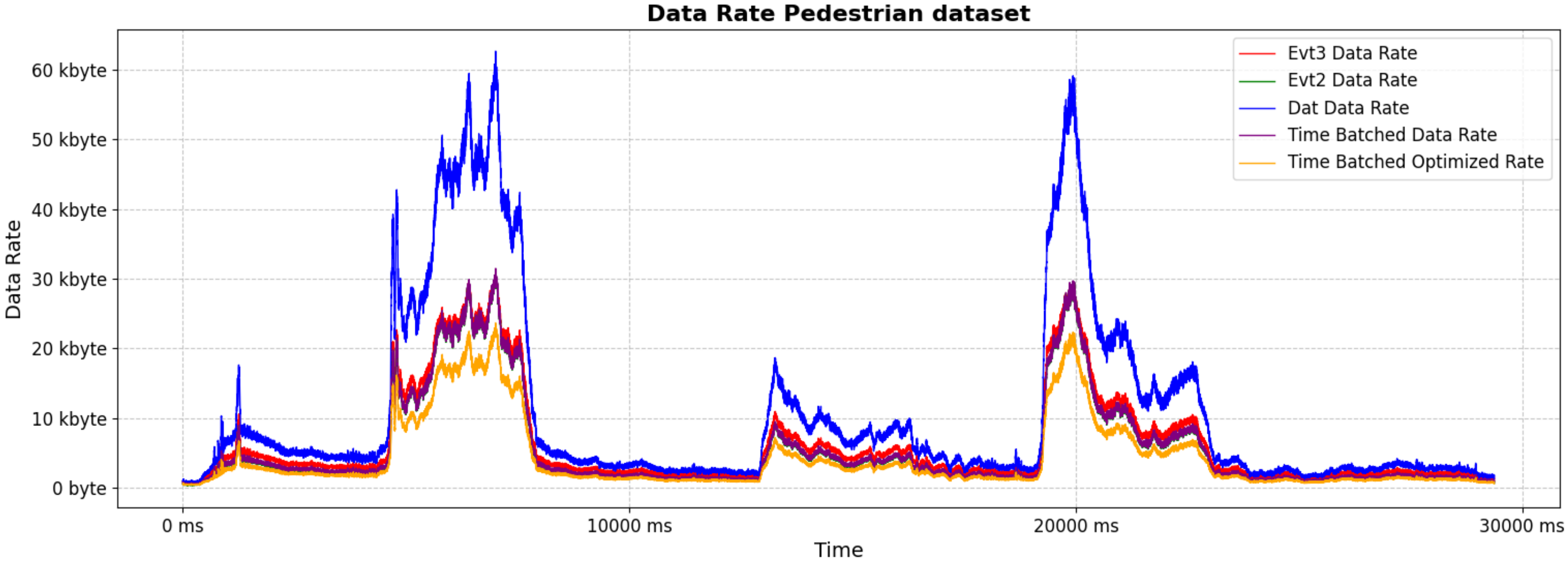
- Read the full image plane within 100 µs and collect all events efficiently.
- Our solution enables implementing a **simple** encoding that delivers performance equal to or exceeding state-of-the-art standards.
- For example:

Time batched	
Header	**128**
timestamp	64
num positive	32
num negative	32
Positive Data * num positive	**32**
x coordinate	16
y coordinate	16
Negative Data * num negative	**32**
x coordinate	16
y coordinate	16

Time batched Optimized	
Header	**128**
timestamp	64
num positive	32
num negative	32
Positive Data * num positive	**24**
x coordinate	12
y coordinate	12
Negative Data * num negative	**24**
x coordinate	12
y coordinate	12

Why “Take control of the read-out”?

Simplify the interface and optimized data transmission



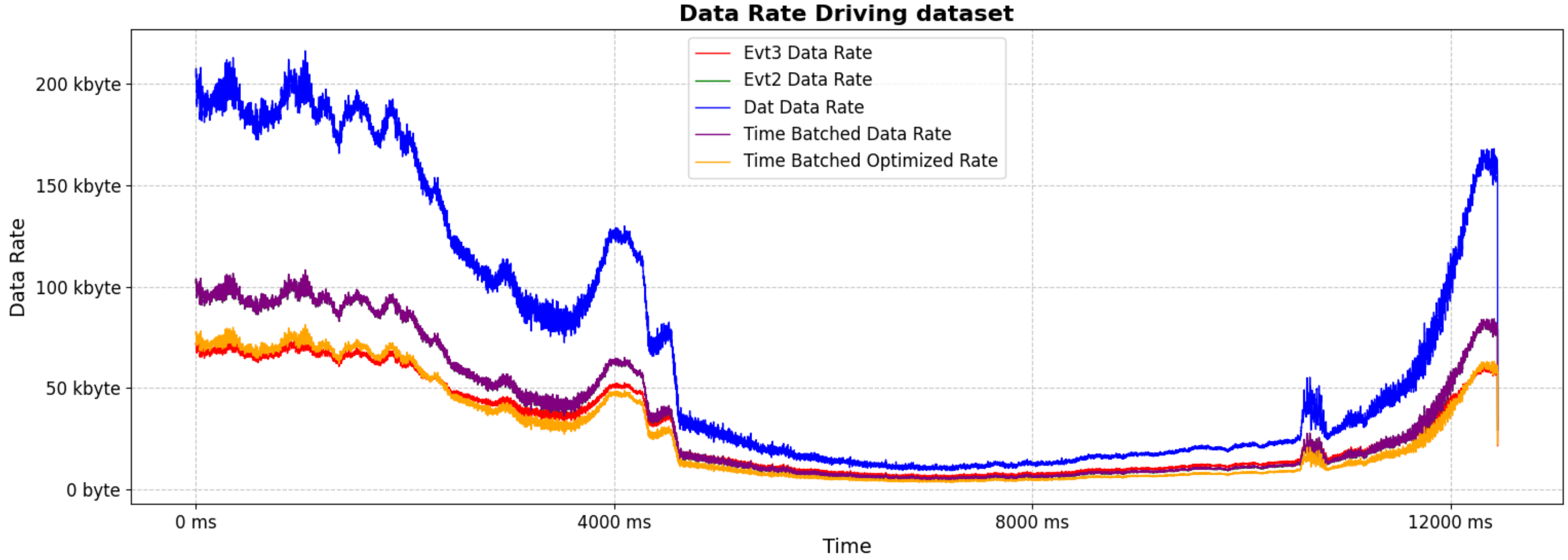
Average data rate:

- Evt3 Data Rate (MB/s): 6.00
- Evt2 Data Rate (MB/s): 5.14
- Dat Data Rate (MB/s): 10.21
- Time Batched Data Rate (MB/s): 5.26
- Time Batched Optimized Data Rate (MB/s): 3.98

https://docs.prophesee.ai/stable/datasets.html

Why "Take control of the read-out"?

Simplify the interface and optimized data transmission



Average data rate:

- Evt3 Data Rate (MB/s): 28.14
- Evt2 Data Rate (MB/s): 34.20
- Dat Data Rate (MB/s): 68.33
- Time Batched Data Rate (MB/s): 34.32
- Time Batched Optimized Data Rate (MB/s): 25.78

https://docs.prophesee.ai/stable/datasets.html

Tempo Sense New Sensor – Coming H2 2026!

	Event-Driven Dynamic Vision Sensors (eDVS)									
	Prophesee GENX320	Sony IMX636	Sony IMX646	Prophesee ISSCC'20	CelePixel CVPR'19	Insightness '18	Samsung ISSCC'17	iniVation JSSC'14	iniVation DVXplorer	Tempo Sense STUN 1
Technology	65nm BSI + 40nm CMOS	90nm BSI CIS + 40nm CMOS	90nm BSI CIS + 40nm CMOS	90nm BSI CIS + 40nm CMOS	65nm CIS	180nm 1P6M CIS	90nm 1P5M	0.18μm 1P6M	90nm BSI CIS	65nm BSI CIS + 40nm CMOS
Resolution	320x320	1280 x 720	1280 x 720	1280 x 720	1280 x 800	320 x 262	640 x 480	240 x 180	640x480	1280x960
Chip Area (mm^2)	3 x 4	6.22 x 3.5	6.22 x 3.5	6.22 x 3.5	14.3 x 11.6	5.3 x 5.3	8 x 5.8	5 x 5	8 x 5.8	12 x 9.7
Pixel Size (μm^2)	6.3 x 6.3	4.86 x 4.86	4.86 x 4.86	4.86 x 4.86	9.8 x 9.8	13 x 13	9 x 9	18.5 x 18.5	9 x 9	7.8 x 7.8
Fill Factor (%)	-	77	77	77	8	22	11	22	-	90
Supply Voltage (V)	1.1 / 2.5	1.1 / 2.5	1.1 / 2.5	1.1 / 2.5	1.2 / 2.5	1.8 / 3.3	1.2 / 2.8	1.8 / 3.3	1.2 / 1.8 / 2.8	1.1 / 2.8
Power (mW) (at 100 Keps)	~3	32	32	32	-	20	22	14	~30	TBD
Max. Power (mW)	36	205	205	205	400	70	34	14	<700	TBD
Energy Efficiency (pJ / pixel-event)	-	137	137	137	7,200	2,857	340	-	-	TBD
Typ. Contrast Sensitivity (%)	35	25	25	>11	>10	>15	>9	>11	>13	10
Dynamic Range (dB)	140	86	110	124	120	100	90	120	120	120
Latency (μs) @1Klux	300	100 (9x9 pixels)	800 (9x9 pixels)	100	8	125	65 - 410	12	<1000	100 (full resolution)

Do you want to know more?

Do not hesitate to contact me!

Davide Migliore

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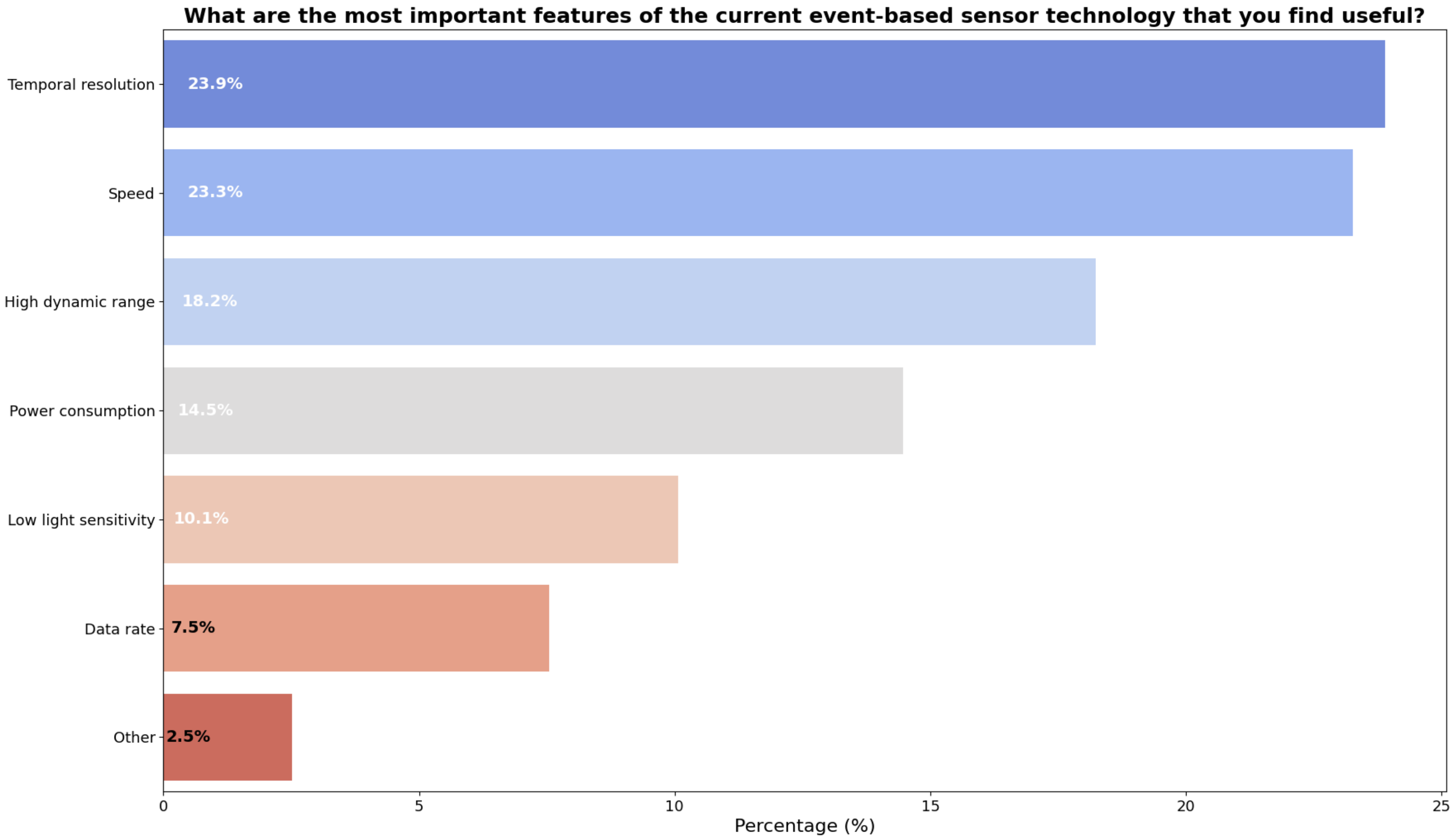
www.tempo-sense.com

And now…
Something completely different


What are the most important features of the current event-based sensor technology that you find useful?
Temporal resolution
23.9%
Speed
23.3%
High dynamic range
18.2%
Power consumption
14.5%
Low light sensitivity
10.1%
Data rate
7.5%
Other
2.5%
0
5
10
15
20
25
Percentage (%)

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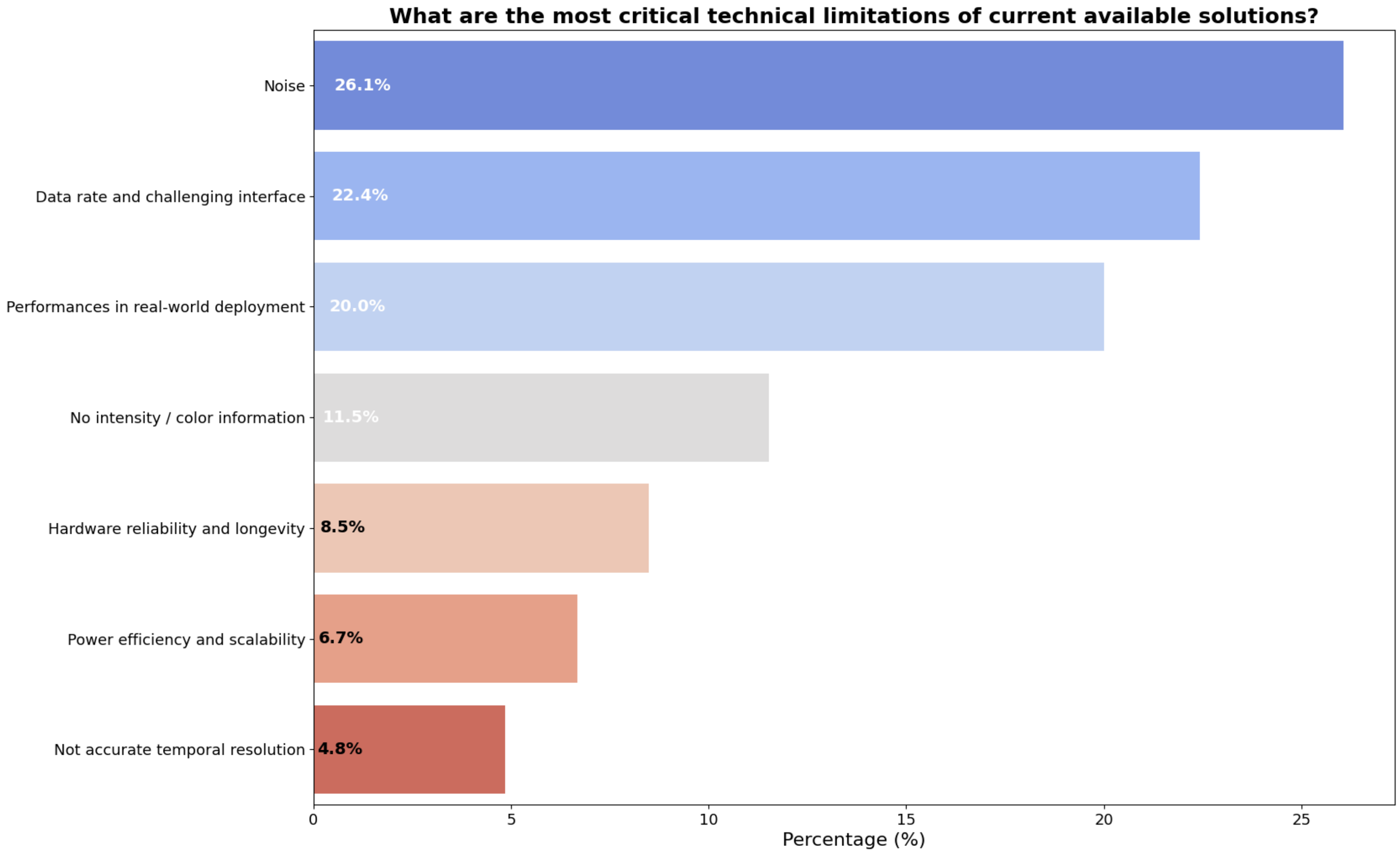
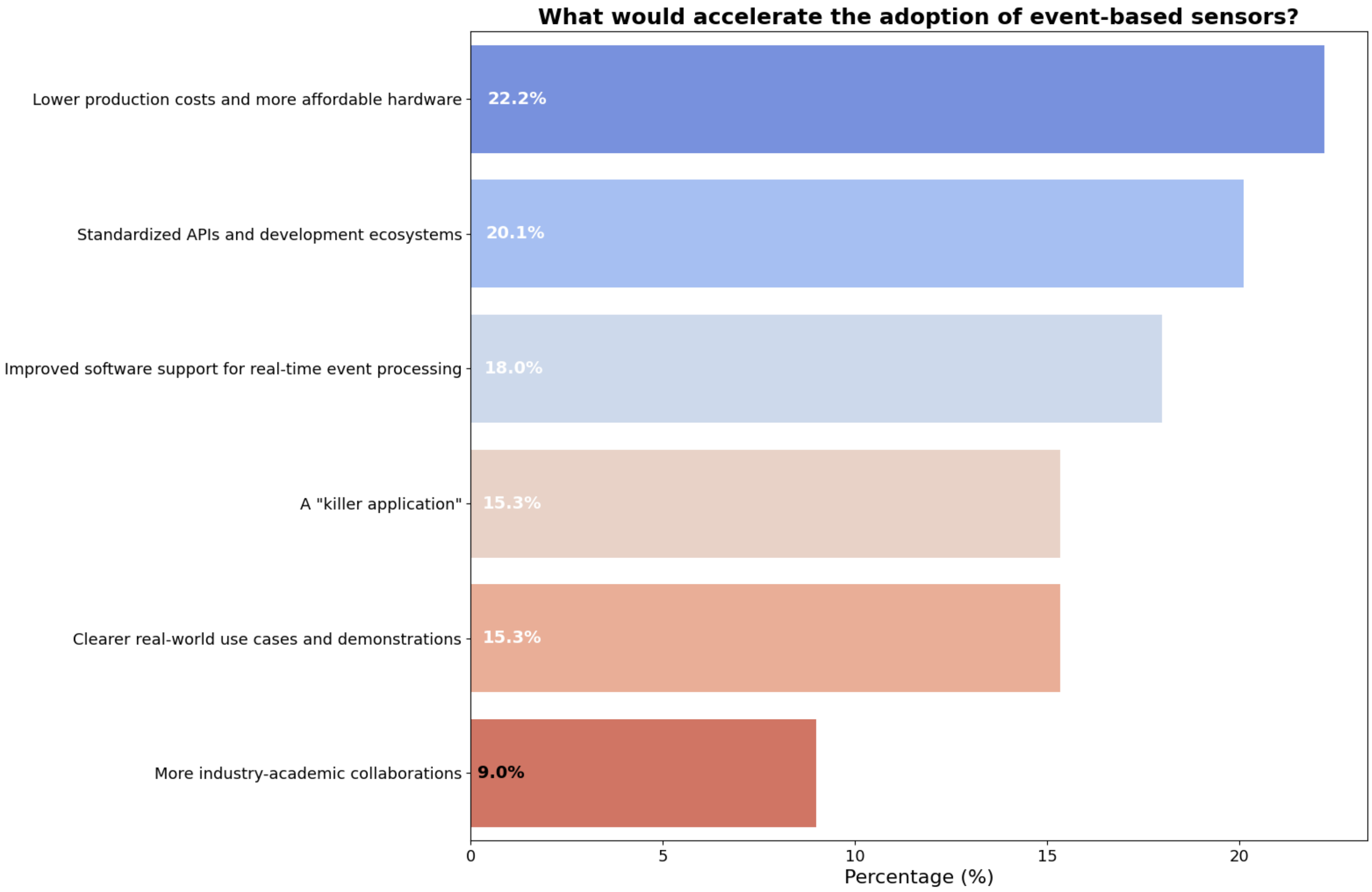
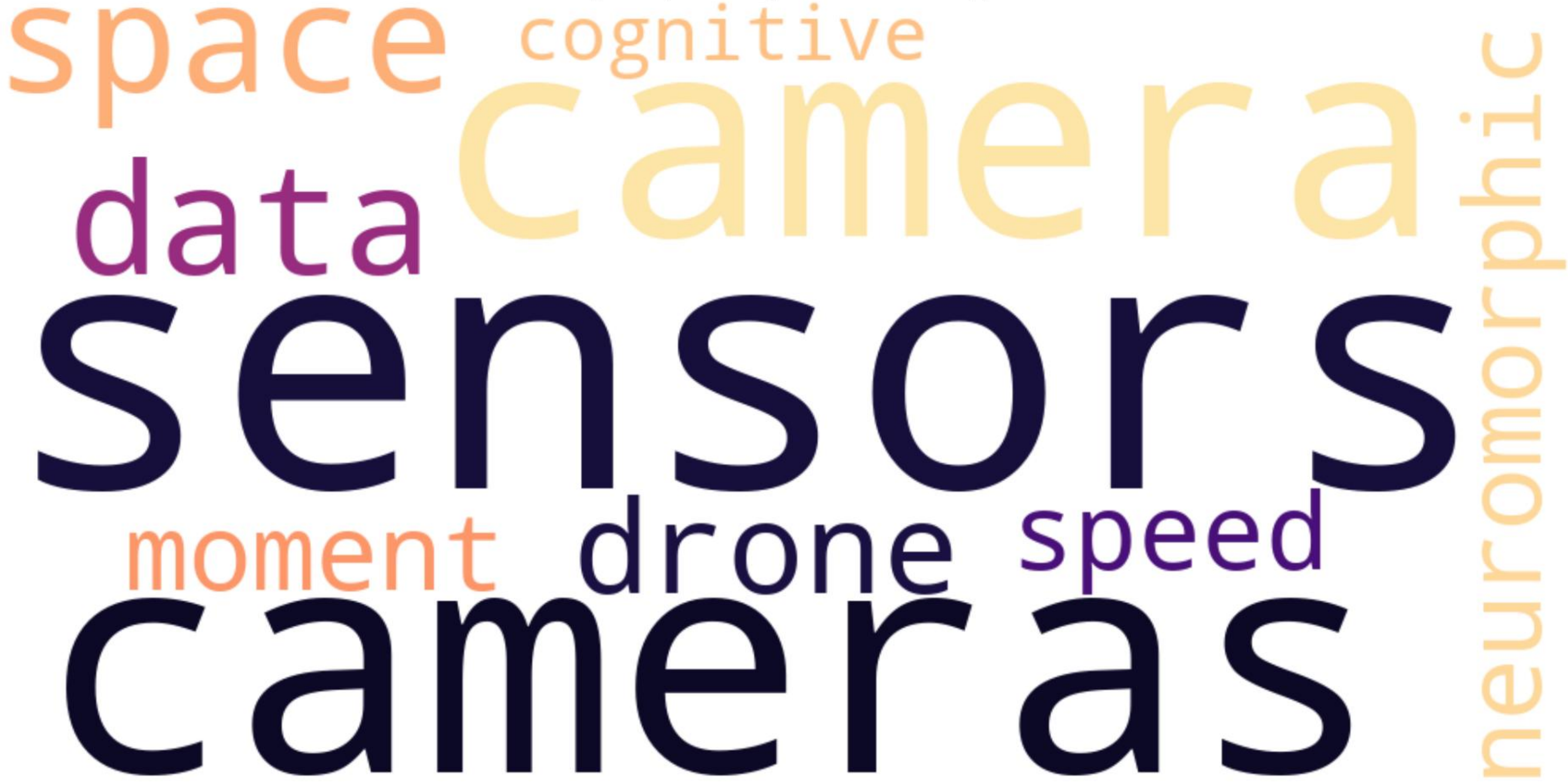
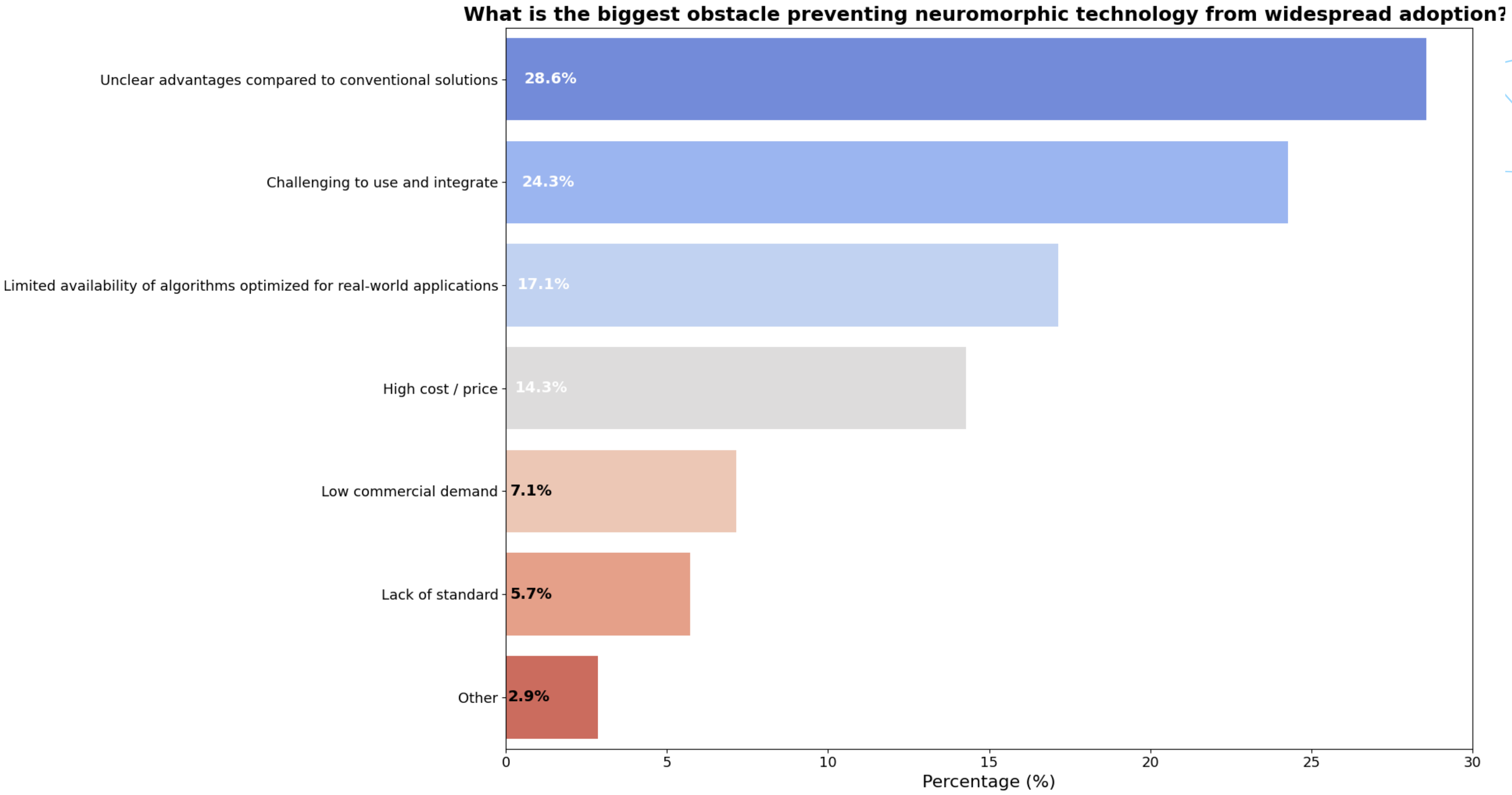

What are the most critical technical limitations of current available solutions?
Noise
26.1%
Data rate and challenging interface
22.4%
Performances in real-world deployment
20.0%
No intensity / color information
11.5%
Hardware reliability and longevity
8.5%
Power efficiency and scalability
6.7%
Not accurate temporal resolution
4.8%
0
5
10
15
20
25
Percentage (%)


What would accelerate the adoption of event-based sensors?
Lower production costs and more affordable hardware
22.2%
Standardized APIs and development ecosystems
20.1%
Improved software support for real-time event processing
18.0%
A "killer application"
15.3%
Clearer real-world use cases and demonstrations
15.3%
More industry-academic collaborations
9.0%
0
5
10
15
20
Percentage (%)

What is in your opinion a possible "killer application"?




What is the biggest obstacle preventing neuromorphic technology from widespread adoption?
Unclear advantages compared to conventional solutions
28.6%
Challenging to use and integrate
24.3%
Limited availability of algorithms optimized for real-world applications
17.1%
High cost / price
14.3%
Low commercial demand
7.1%
Lack of standard
5.7%
Other
2.9%
0
5
10
15
20
25
30
Percentage (%)

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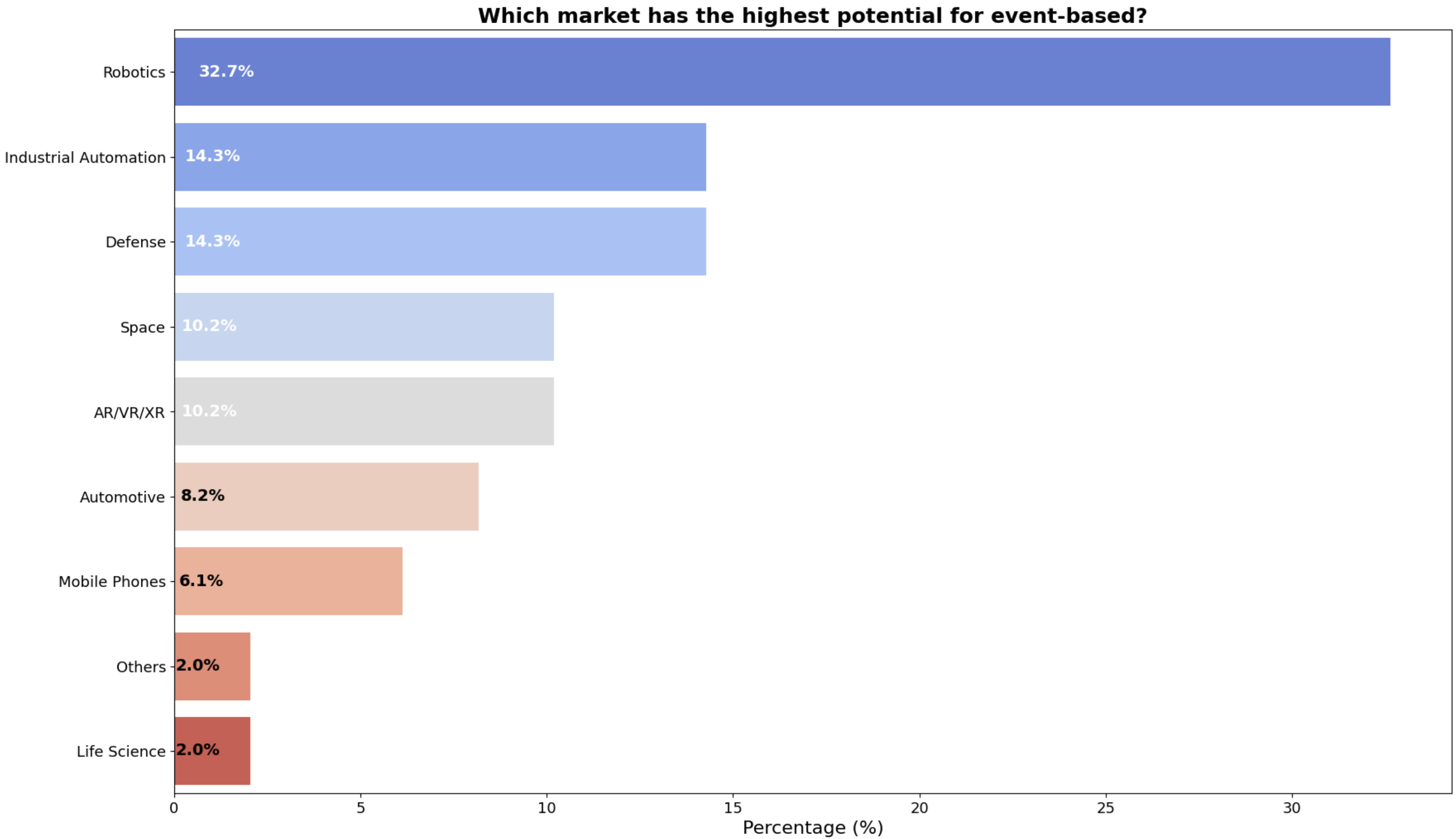
If you choose 'Other,' what do you think is the main obstacle?



Which market has the highest potential for event-based?
Robotics
32.7%
Industrial Automation
14.3%
Defense
14.3%
Space
10.2%
AR/VR/XR
10.2%
Automotive
8.2%
Mobile Phones
6.1%
Others
2.0%
Life Science
2.0%
0
5
10
15
20
25
30
Percentage (%)

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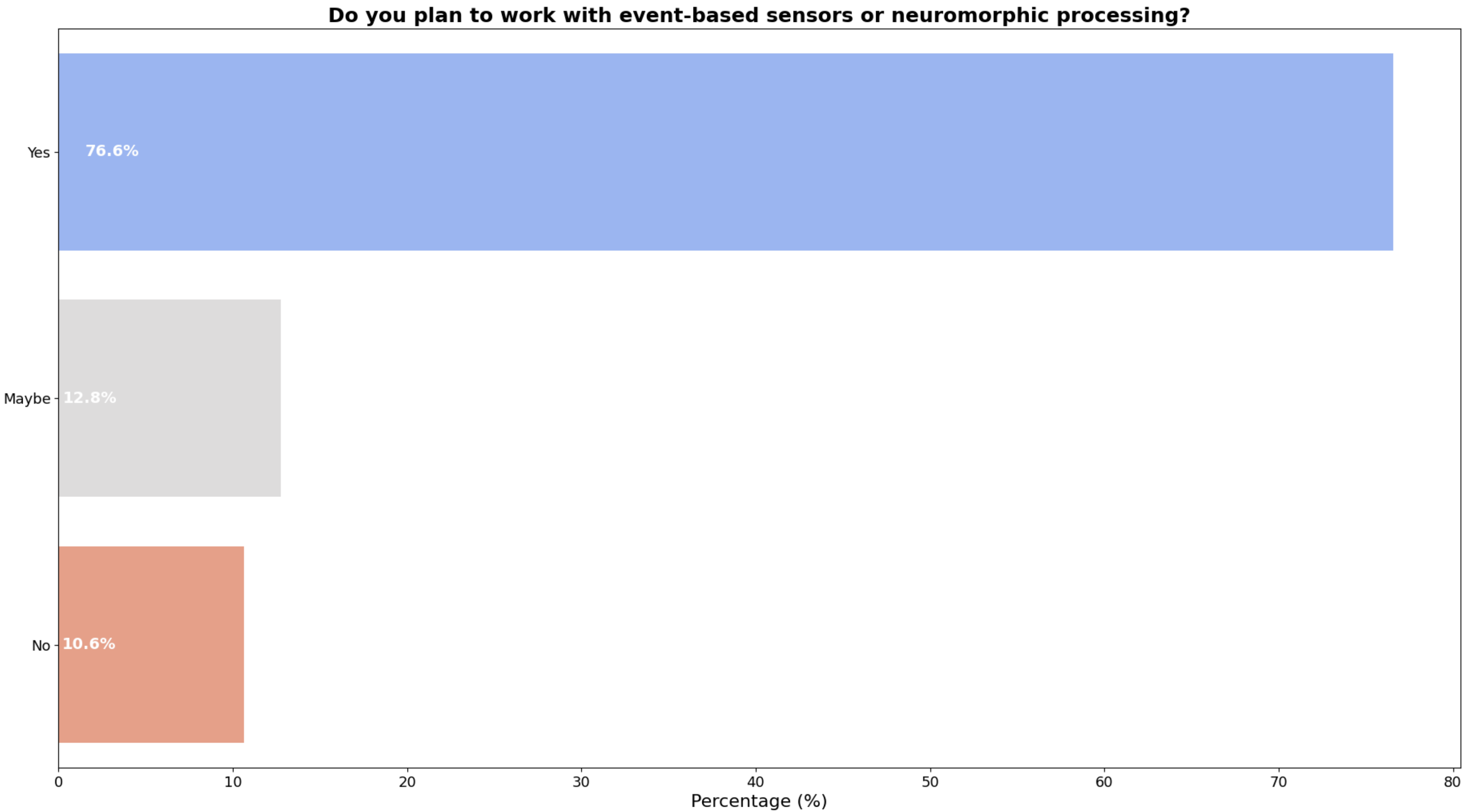
Do you plan to work with event-based sensors or neuromorphic processing?
Yes
76.6%
Maybe
12.8%
No
10.6%
0
10
20
30
40
50
60
70
80
Percentage (%)

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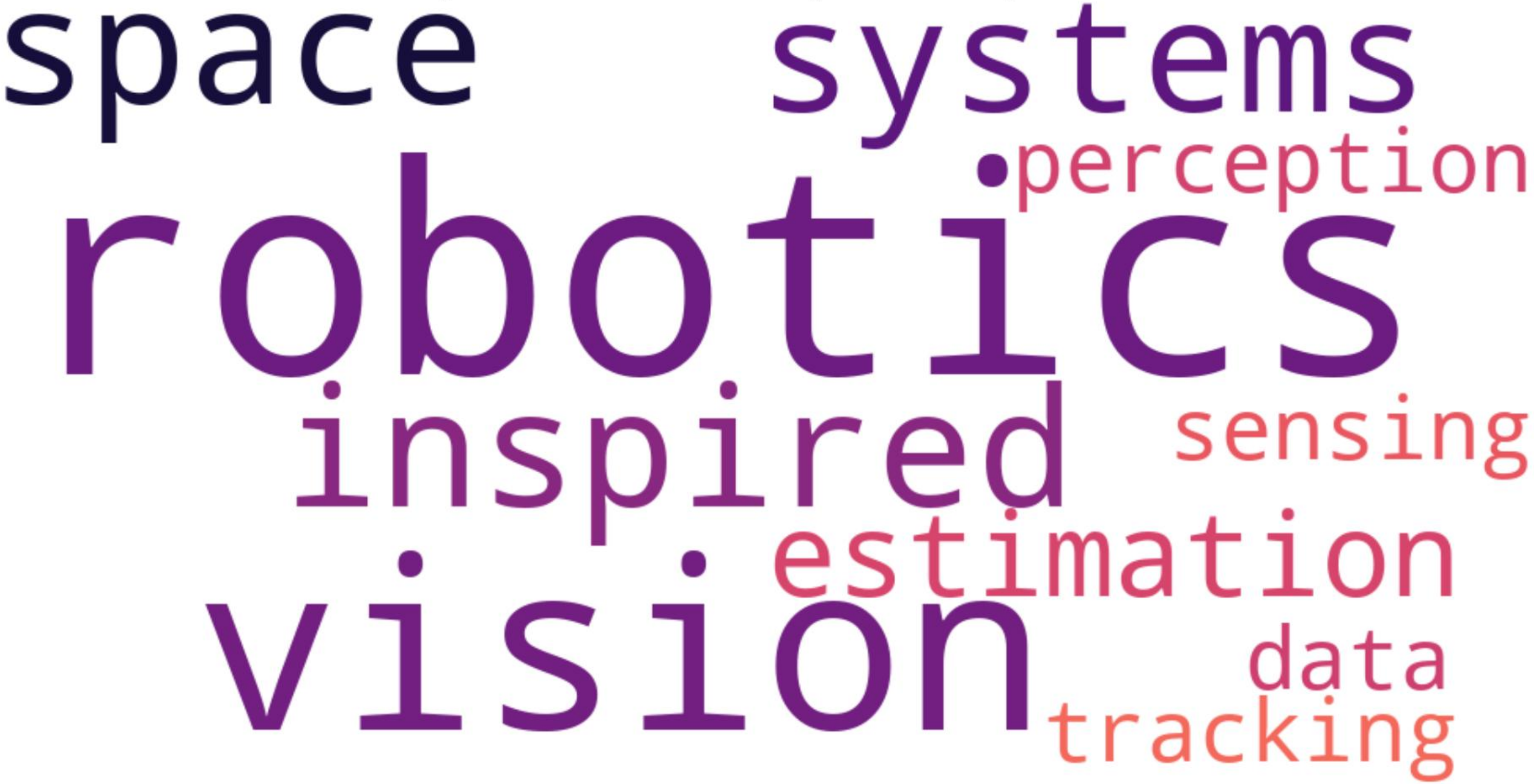
If you answered "Yes". What will your research topic be?



Thank you!