IEEE SA STANDARDS ASSOCIATION

IEEE Sensors Council Standards Committee (SC-SC)
Meeting Minutes
May 20, 2024
Chair: Troy Nagle
Secretary: Chris Schober

1. **Call to Order at 10:03 EST**

2. **Roll Call and Affiliation**
   Affiliation FAQs: link
   Attendance Registration Form: link

3. **Attendees at meeting.**
   Quorum was met
   a. Troy Nagle, North Carolina State University
   b. Chris Schober, Actalent/Honeywell
   c. Eshan Danesh, Advanced Sensing Technologies Ltd
   d. James Covington, University of Warwick
   e. Saba Mylvaganam, University of South-Eastern Norway
   f. Gerald Hayes, Wireless Research Center of North Carolina
   g. Gopalakrishna Kuppa, IEEE Hyderabad Section

4. **Approval of Agenda**
   a. Moved Chris Schober, 2nd by Gerry Hayes, unanimous approval.

5. **Approval of Previous Meeting Minutes**
   a. Moved by Gerry Hayes, 2nd by Eshan Danesh, unanimous approval.

6. **Working Group Updates**
   a. Update on P2520.1 Odor Monitor Baseline Performance (James Covington)
      i. Progressing reasonably well. Focus recently is now on the writing of the standard. Now moving text to IEEE SA document & formatting. Now complete. Been reviewed by a sub-group, and now in 2nd iteration review.
      ii. "Stress points" list created, plan a meeting this summer for decision on these.
      iii. Next phase is to send to a few new people who were not involved in the writing for feedback.
      iv. Pass/Fail criteria now completed.
      v. As a Standard, estimate is 95% completion.
      vi. Next Pass/Fail limits and chemicals chosen to be determined. WG to work on these now.
      vii. PAR P2520.1 currently expires Dec 31, 2024.
      viii. PAR now needs to be extended into 2025. Next meeting of WG, the WG needs to fill out form, submit to SC-SC by end of Sept for approval before PAR expires later this year.
      ix. Gopalakrishna Kuppa noted that they are establishing an IEEE Industry Electronics, the infrastructure will be available soon and can be used to help with our test and demonstration pilot runs. Sensor Testing & Demonstrations would be helpful to add to the Center of Expertise.

x. Gopalakrishna plans to be in the IECON conference in Chicago November of this year and would like to present a paper on sensor fusion. Would like input within the next 15-20 days. P1451.99 does presentations at this meeting.

b. Update on P2520.2.1 General Outdoor Air Odor Monitoring (Ehsan Danesh)
   i. March 2024 meeting held and now focused on landfill odor. He has the equipment but needs to get a landfill sample. The closest lab with the equipment, is in Agriculture research Organization in Israel. But funds are needed to do that lab work, they cannot do outside volunteer work. The new initiative funding is for P2520.1, but not for P2520.2.1.
   ii. Troy Nagle discussed the New Initiative funding that was approved by Sensors Council ($15k per year for 2 years) . Troy requested proposals on how to spend this initiative and will have a meeting to discuss this.
   iii. PAR needs to be extended at least 2 more years to allow for P2520.1 to finish first, then P2520.2.1. Plan is to submit the paperwork by the WG (request available online on SA site) to extend the PAR.

c. Update on P1451.99 IoT Harmonization (Gopalakrishna Kuppa)
   i. Update included with P2520.1 above
   ii. Sensor Registry is of interest to the P1451.99
   iii. Focus now on wireless transducer interface modules to integrate with test demo. Plan to use students to learn and perform some of this work.

7. Unfinished Business/Action Items

a. SC-SC Policies & Procedures Update (Troy Nagle)
   i. Presented changes in-process of review at IEEE SA after many changes were requested in 1st draft. They were approved by IEEE-SA on Feb 15.
   ii. April 28th Sensors Council approved it.
   iii. Since then, we have been notified by IEEE SA that we may need another update based on changes they have incorporated.
   iv. Troy Jerry and Chris will go through the records and notify who the voting members are now per the updated policy prior to the August 2024 meeting.

b. Update on Sensors Council Industry Liaison Committee (Gerry Hayes)
   i. Call out for volunteers for the new SC ILC committee. They are in the active planning stage to get more people interested in the SENSORS conference ILC.

c. IEEESA ICAID on Enabling a Smart and Equitable Agriculture Ecosystem (Jack Marck, update by Troy)
   i. Jack Marck Message from a week ago, that all is going well.

d. IEEE Std 2700-2017 Sensor Performance Parameter Definitions (Micheal Gaitan)
   i. Last year, the Standards Association asked us to house this standard. We searched for some active volunteers to revive the WG but failed.
   ii. The Std is coming up on its 10-year refresh stage.
   iii. Gopalakrishna may be interested in helping this by stepping forward to see if he can find 1-2 people who are interested.

e. AI search for new standard projects (Saba Mylvaganam)
   i. Noted that the Smart City project may be interested in odor sensors. Saba would like to interface with SC-SC and Smart City for potential collaborations.

ii. Search tuned to different possibilities for sensors (robots & sensors). Holland is already using robots to get photos of each plant and analyze what chemicals/parasites they can use to help with tulip and strawberry farms.
iii. Update of new research done for SC-SC. Document attached *("Addendum to the AI-generated briefing distributed in the last SC-SC Meeting 18.02.2024")*
iv. The search also included the benefits of following standards, and who is making odor sensing devices. Definitions of the key words used in odor sensing were mined.
v. Saba requests that we all look at their document and send feedback

8. New Business

a. "*Sensors Council Standards Committee IEEE Resources for Volunteers*" (Troy Nagle)
Troy shared his handy reference includes links on what is needed for this committee. See attached document "*Sensors Council Standards Committee IEEE Resources for Volunteers*". Attached to minutes. Chris & Troy will look at a place to store this, so it is very handy for our SC-SC.

b. Peng Hu (joined the meeting late)–Possible TAB committee Standards proposal discussion.
i. Project Title: "Standardizing Intelligent sensing on LEO satellites for space sustainability, in-orbit servicing and Internet of Things."
ii. Peng Hu proposal is the standardize sensors to support these activities.
iii. Planning to submit a proposal via TCoS initiative.

9. Future Meetings

SC-SC meetings planned for 2024: August 19, and November 18

10. Meeting Adjourned at 11:00 am EST

Attachments

1. *Addendum to the AI-generated briefing distributed in the last SC-SC Meeting 18.02.2024. (Saba Mylvaganam)*
2. *Sensors Council Standards Committee IEEE Resources for Volunteers*" (Troy Nagle)

Addendum to the AI-generated briefing distributed in the last SC-SC Meeting 18.02.2024.

Meant for SC-SC Meeting of 20.05.2024

1. **Latest details of new standard projects related to odor/odour sensing, internationally.**

One of the latest standard related to odour sensing is the **EN13725:2022**, a revised European Standard for Olfactometry[1]. This standard, published in March 2022, is the first significant update in 17 years[1]. It's worth noting that odour nuisance is the second cause of environmental complaints, after noise[2].

2. **Update on latest breakthroughs in odor/odour sensing and companies marketing odor/odour sensors**

A significant breakthrough in odour sensing is the development of **biomimetic olfactory chips** by a research team at the Hong Kong University of Science and Technology[5]. These chips integrate nanotube sensor arrays on nanoporous substrates with up to 10,000 individually addressable gas sensors per chip[5]. A company marketing odour sensors is **Oizom**, which uses advanced e-nose technology to continuously detect and track odorous gases[6].

3. **Applications in the defence sector using odor/odour sensors**

While specific applications in the defence sector are not mentioned in the search results, odour detection methods such as olfactometry and chemical sensors have been discussed in the context of environmental monitoring[78].

4. **Industrial actors dealing with robots/robotics/cobots/humanoids using odor/odour sensors in their sensor**

The search results do not provide specific information about Boston Dynamics or other robotics companies incorporating odour sensors in their robots. However, cobots (collaborative robots) are designed to work safely and efficiently alongside human workers, and advances in sensors, AI, and robotics have made them much more sophisticated and capable[9].

Regarding the principle of odour sensing, sensor type used, information on hardware/software used, and the processing chips used, odours are mixtures of light and small molecules that stimulate an anatomical response when they come into contact with various human sensory systems[7]. Electronic noses (E-Noses) are devices that could detect and recognize odours and flavours[10]. They use sensor arrays and pattern recognition systems to mimic human olfaction[10].

5. Quantum Computing and Ternary Logic for Real Time Applications of Odor Sensors

As for the application of quantum computing and ternary logic in odour sensing applications, the search results do not provide specific information on these topics. However, there is ongoing research to give computers a sense of smell, which involves mapping how we perceive odours[11]. Ternary logic has been used to decrease delay, power consumption, and chip area of ternary circuits[12]

1 silsoeodours.com2 ebcd.org3 2024.ieee-fleps.org4 ieee-sensors.org5 sciencedaily.com6 oizom.com7 mdpi.com8 mdpi.com9 futurebridge.com10 en.wikipedia.org11 theguardian.com12 link.springer.com13 electronicsforu.com14 link.springer.com15 universal-robots.com16 medium.com17 mdpi-res.com18 mdpi.com19 mdpi-res.com20 mdpi.com21 pubs.acs.org22 ieeexplore.ieee.org23 ieeexplore.ieee.org24 ieeexplore.ieee.org25 ieeexplore.ieee.org26 ieeexplore.ieee.org27 ieee-sensors.org28 ieee-sensors.org29 mdpi-res.com30 mdpi.com31 digikey.in32 mdpi.com33 mdpi.com34 researchgate.net35 mdpi.com36 doi.org37 doi.org38 doi.org39 doi.org40 ieeexplore.ieee.org41 ieeexplore.ieee.org42 ieeexplore.ieee.org43 doi.org44 doi.org

6. More information on biomimetic olfactory chips and manufacturers

Biomimetic olfactory chips (BOCs) are a significant advancement in odour sensing technology. They are designed to mimic the way humans and animals detect odours, making them more accurate and efficient than previous artificial olfaction systems[12345]. A research team at the Hong Kong University of Science and Technology (HKUST) has developed these chips. They integrate nanotube sensor arrays on nanoporous substrates with up to 10,000 individually addressable gas sensors per chip[12]. The team, led by Prof. FAN Zhiyong, used an engineered material composition gradient that allows for wide arrays of diverse sensors on one small nanostructured chip[12].

7. **Challenges in odour sensing**

Odour sensing faces several challenges:

- **Biological recognition elements**: The biological elements used for recognition in odour sensing can be complex and challenging to replicate[6].
- **Immobilization methods and sensor formats**: The methods used to immobilize the sensing elements and the formats of the sensors themselves can present challenges[6].
- **Specificity of sensors**: Most electronic noses face a significant challenge in terms of the specificity of the sensors[7].
- **Sample contamination and degradation**: Sample contaminations can easily occur if unsuitable or unclean materials are used. Furthermore, samples inevitably degrade or alter over time[8].

8. **Impact of quantum computing on odour detection**

Quantum computing, based on quantum mechanics, is evolving with the aim of solving problems that traditional computing is unable to solve[9]. In the context of odour detection, there is ongoing research to give computers a sense of smell, which involves mapping how we perceive odours[10]. While specific applications of quantum computing in odour detection are not mentioned in the search results, the potential for quantum computing to enhance the processing and analysis of complex odour data is significant.

9. **Effect of ternary logic chips on odor sensing applications**

Ternary logic chips, which use three states instead of the two used in binary logic, could potentially impact odour sensing applications. While specific applications of ternary logic chips in odour sensing are not mentioned in the search results, the use of ternary logic can decrease delay, power consumption, and chip area of ternary circuits[11]. This could potentially enhance the efficiency and performance of odour sensing systems. However, more research is needed in this area to fully understand the potential benefits and applications.

1 sciencedaily.com2 techxplore.com3 roboticsintl.com4 thedigitalinsider.com5 aiguido.com6 mdpi.com7 dspace.mit.edu8 mdpi.com9 link.springer.com10 theguardian.com11 openarchive.usn.no12 link.springer.com13 doi.org14 doi.org

10. More details on the ISO standards related to odour sensing

The International Organization for Standardization (ISO) has developed several standards related to odour sensing. For instance, ISO 13301:2018 provides guidelines for obtaining data on the detection of stimuli that evoke responses to odour, flavour, and taste by a three-alternative forced-choice (3-AFC) procedure[1]

1 iso.org2 iso.org3 iso.org4 mdpi.com5 odourobservatory.org6 oizom.com7 odourobservatory.org8 mdpi.com9 mdpi.com10 dspace.mit.edu11 oak.kribb.re.kr12 cell.com13 link.springer.com14 mdpi.com15 mdpi.com16 envirotech-online.com17 mdpi.com18 mdpi.com19 doi.org20 doi.org21 doi.org22 creativecommons.org

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12. Challenges associated with Implementing standardised odour sensing technologies

1. **Specificity of Sensors**: Most electronic noses face a significant challenge in terms of the specificity of the sensors[1]. This is because odours are complex mixtures of volatile compounds, and it can be difficult for sensors to accurately and specifically detect each component[1].
2. **Biological Recognition Elements**: The biological elements used for recognition in odour sensing can be complex and challenging to replicate[1]. These elements are crucial for the sensor's ability to mimic biological olfaction[1].
3. **Immobilization Methods and Sensor Formats**: The methods used to immobilize the sensing elements and the formats of the sensors themselves can present challenges[1]. These factors can affect the sensor's performance and reliability[1].
4. **Visualisation of Odour Space**: Visualising the spatiotemporal distribution of odours using conventional sensor technologies is a difficult task due to the limited spatiotemporal resolution[2]. This is a significant challenge when trying to monitor and map odours in the environment[2].
5. **Physiological Limits/Impairments**: There are physiological limits to odour perception, such as anosmia (impairment of the sense of smell), which can affect the general suitability of a person for conducting sensory tests[3].These challenges highlight the complexity of odour sensing and the need for ongoing research and development in this field. It's worth noting that despite these challenges, significant

progress has been made in the development of odour sensing technologies[12].

1 mdpi.com2 link.springer.com3 dlg.org4 doi.org

13. Benefits to companies from adhering to these standards

Adhering to odour sensing standards can provide several benefits for companies[123]:

- **Operate Professionally**: Upholding international environmental management standards, such as ISO 14000, helps industries not only detect but also strategise on odour management[1].
- **Enhance Community Relations**: By investing in odour monitoring and sharing real-time data with local residents, companies can showcase transparency and commitment, significantly bolstering their community image[1].
- **Compliance with Regulations**: Adherence to standards ensures that companies are in compliance with environmental regulations, which can prevent potential legal issues and fines[3].
- **Improved Product Quality**: Standards often provide guidelines for best practices that can lead to improved product quality and consistency[3].

14. Improving the specificity of odour sensors

Improving the specificity of odour sensors can be achieved through several methods[4567]:

- **Use of Advanced Materials**: The use of advanced materials such as nanotubes, molecularly imprinted polymers, and molecular sieve materials can enhance the specificity of sensors[46].
- **Machine Learning Techniques**: Machine learning techniques can be used to improve the specificity of odour sensors by allowing for more accurate pattern recognition and prediction[4].
- **Sensor Calibration**: Regular calibration of sensors can help maintain their accuracy and specificity[6].
- **Bio-inspired Design**: Designing sensors that mimic biological olfaction can improve specificity[4].

15. Emerging technologies in odour sensing

Emerging technologies in odour sensing include[859]:

- **Bioelectronic Noses**: These devices use bio-receptors to identify gases and vapours, mimicking mammalian olfaction[5].
- **Machine Learning-Enabled Electronic Noses**: These devices use machine learning methods for precise odor identification with both qualitative and quantitative analysis[8].
- **Optical Sensing Technologies**: These technologies, based on fluorescence imaging and localized surface plasmon resonance (LSPR), are being developed to visualize the spatiotemporal distribution of odorants in the environment[9].

16. Interdisciplinary approaches to address challenges related to odor sensing

There are interdisciplinary approaches to address the technical challenges related to odor sensing[101112]:

- **Interdisciplinary Teams**: Teams composed of experts from different fields such as bench chemistry, computational chemistry, machine learning, and machine learning interpretability are working together to tackle the challenges of odor sensing[10].
- **Combination of Molecular Recognition Technologies**: Various molecular recognition technologies are being combined to construct an artificial odor map and to evaluate the odor quality[11].
- **Integration of Nanoelectronic Technology and Olfactory Receptors**: Biosensor systems that combine nanoelectronic technology and olfactory receptors themselves as a source of capturing elements for biosensing are being developed[5].

1 oizom.com2 odourobservatory.org3 odourobservatory.org4 mdpi.com5 mdpi.com6 mdpi.com7 mdpi.com8 mdpi.com9 oak.kribb.re.kr10 cell.com11 link.springer.com12 mdpi.com13 dspace.mit.edu14 envirotech-online.com15 doi.org16 doi.org17 doi.org

17. Bioelectronic noses, HW/SW used and HW/SW integration, including usage of Edge vs. cloud-based computing

Bioelectronic noses are devices that use bio-receptors to identify gases and vapours, mimicking mammalian olfaction[1]. They involve both a sensor—acting as the nose or receptor for odor molecules – and associated software which interprets information from the sensor based on a database of previously collected and analyzed odors[2].

In terms of hardware and software integration, bioelectronic noses typically involve the following[31]:

- **Edge Devices**: An edge device can be any type of hardware that manages the boundary between two networks[4]. These devices control the flow of data between service providers and users[4].
- **Edge Data Centers**: Edge data centers are smaller data centers that are located near the edge of a network[4]. They can be used to deliver cloud computing resources to edge devices[4].

When it comes to edge vs. cloud-based computing, each has its pros and cons[54678]:

- **Edge Computing Pros**: Improved response times and latency across all devices, decreased data real estate creates less risk in corporate security, reduced bandwidth reduces transmission costs[5].

- **Edge Computing Cons**: Geographic disparities: fewer network devices and skilled implementers, greater difficulty preventing and monitoring security breaches, loss of data with potential energy cost and storage capacity needs[6].
- **Cloud Computing Pros**: The cloud handles large amounts of data and processing power while edge computing handles local data processing. It reduces the amount of data that needs to be sent to the cloud[7].
- **Cloud Computing Cons**: Cloud computing may be less scalable than edge computing because processing and storage resources are limited to devices and local gateways

18. List of some manufacturers of odor sensing devices

Here are some manufacturers of odor sensing devices[9]:

1. **Zhengzhou Winsen Electronics Technology Co., Ltd.**
2. **Autodesk Inc.**
3. **Bosch Sensortec**

These companies are ranked as the top smell sensor manufacturers as of May, 2024[9].

1 en.wikipedia.org2 aryballe.com3 link.springer.com4 coursera.org5 datamation.com6 xcally.com7 unite.ai8 kio.tech9 us.metoree.com10 mdpi.com11 olfasense.com12 doi.org13 doi.org14 doi.org15 doi.org16 doi.org17 doi.org18 mdpi.com19 linkedin.com20 researchmap.jp21 doi.org

19. Case study - Konica Minolta Kunkun X, a solution with cutting-edge technology (From Odor detection technology - Technology | KONICA MINOLTA)

In view of the wide range of problems relating to odors, there are many potential needs for odor control solutions in the world.

Konica Minolta has launched products incorporating its odor detection technology, such as Kunkun body and Kunkun dental, which are designed to measure body odors and VSC (VSC stands for Volatile Sulfur Compounds and includes hydrogen sulfide (H2S), methyl mercaptan (CH3SH), and dimethyl sulfide ((CH3)2S) odors, respectively.

Konica Minolta will continue to work in collaboration with its partner companies and groups to deliver new Kunkun X solutions to the world's markets.

20. SMELL, ODOR/ODOUR, olfactometry and their usages in conjunction with odor control

Some aspects related to olfactometric control, i.e. removing unpleasant odors and enhancing or supplying pleasant smells using.

Term	Usage in Odor Control
SMELL	Smell control involves managing the perception of volatile compounds. This can be achieved by removing unpleasant smells or enhancing pleasant ones.
ODOR/ODOUR	Odor control often involves techniques to eliminate or reduce the release of odorous compounds. This can include controlling the precursors to malodor formation, diluting odors below the detection threshold, reducing or inhibiting emission, or transforming the odors to something less odorous[5].
OLFACTOMETRY	Olfactometric control involves using olfactometry techniques to measure and manage odors. For instance, dynamic dilution olfactometry can be used to determine odor concentration and threshold, assess the degree of appreciation, evaluate the relative intensity of odors, and train expert panels[4].

In conclusion, smell, odor/odour, and olfactometry are all crucial aspects of odor control. They each play a unique role in identifying, measuring, and managing odors to improve air quality and reduce nuisance.

1 mdpi.com2 azosensors.com3 mdpi.com4 en.wikipedia.org5 store.extension.iastate.edu6 jfmed.uniba.sk7 odourobservatory.org8 bioairsolutions.com9 ecomena.org10 astm.org11 doi.org12 doi.org

Sensors Council Standards Committee
IEEE Resources for Volunteers

Required Training: IEEE-SA Training & Development (link)

IEEE Learning Network (link)**:**

- Understanding IEEE SA's Antitrust, Competition, and Commercial Terms Policies (This training is mandatory for all IEEE SA **Standards Committee** and **Working Group Officers.**)
- Working Group Chair Fundamentals Course
- IEEE SA Copyright Policy Course
- Data Privacy Awareness for IEEE SA Activities

Supporting Programs

- IEEE-SA Sensors Registry (link)
- IEEE-SA Open-Source Initiative (link); background (link)
- IEEE-SA Conformity Assessment Program (ICAP) (link)
- IEEE TAB Committee on Standards (TCoS) (link)

Policies & Procedures:

- SC-SC P&P (link)
- Simplified Working Group P&P Baseline (link), Instructions (link)
- Working Group Publishing Guidelines (link)

IEEE-SA Supporting eTools:

- MyProject (link)
- iMeet Central (link)
- Cisco Webex (link)
- Listserv Management (link)
- WordPress Websites (link)
- Membership Validator (link)