

Celebration of the Hilton Head Workshop's 40th Anniversary: A Transducer Research Foundation Premier Conference

In the past 40 years the micro-electro-mechanical (MEMS) field has evolved from one where researchers envisioned and built modular sensors and solutions, to one where it is possible to imagine and create components to address larger grand challenges. During this time, the [Transducer Research Foundation](#) (TRF) has played a significant role in establishing a culture, sharing information, and mentoring future leaders in the field.

“Over the years, TRF has played a vital, impactful role as a non-profit guiding organization in the MEMS community, nationally and internationally,” says current TRF President Reza Ghodssi. “The principal mission of TRF has always been to maintain and raise the stature of excellence in our community, and in June 2024 we are celebrating the 40th anniversary of one of our premier sponsored conferences, the Hilton Head Workshop.”

Recently, a group of TRF pioneers with extensive knowledge of its history and conferences reflected on TRF's history, present and future. This document includes remembrances from:



- [Stephen Senturia](#), professor emeritus at the Massachusetts Institute of Technology, author of academia-related fiction and TRF president from 2004–2010).



- [Kurt Petersen](#), former head of the IBM micromachining research group, co-founder of NovaSensor, Cepheid, and SiTime. Petersen was the program chair of the first Hilton Head Workshop and General Chair of the second Hilton Head Workshop. He is also the recipient of the IEEE Medal of Honor for his contributions to the commercialization of MEMS.



- [Joseph Giachino](#), Ford Motor Company (retired) and University of Michigan, treasurer for the first Hilton Head Workshop and treasurer of TRF from its inception through 2006.



- [Thomas Kenny](#), professor at Stanford University (and TRF president from 2016–2022), who had just completed his Ph.D. and begun work at the Jet Propulsion Laboratory when he attended the first Hilton Head Workshop.



- [Reza Ghodssi](#), Herbert Rabin Distinguished Chair and professor at the University of Maryland. TRF president since 2022.



- [Katharine Cline](#), founder and former president of Preferred Meeting Management, Inc. (PMMI), longtime executive director (2000–2022) of TRF.



TRF is a nonprofit organization with a mission to stimulate research in science and engineering, emphasizing technologies related to transducers, microsystems, and nanosystems. TRF fosters idea and information exchange among academic faculty and students, industry, and government researchers.

TRF has a twofold mission. First, it sponsors conferences, workshops, seminars and short courses for academia and the microsystems industry. These meetings provide a technical track of the highest quality along with opportunities for discussion and networking. Second, student participation is a key element.

Students are essential to the future growth of the microsystems industry, and the meetings are designed to provide training, mentoring, networking, and idea exchange. Proceeds raised during sponsored events not only go into future conferences, but also to scholarship funds that enable student participation.

Through the years, TRF scholarships have helped thousands of students attend the Hilton Head Workshops, Transducers Conferences, IEEE MEMS Conferences, TRF Napa Workshops, [International Conference on Networked Sensing and Systems](#) (INSS), and PowerMEMS and MMB Workshops.

“Students have taken advantage of face-to-face interactions with international academic, industry, and governmental leaders in MEMS and solid-state sensors and actuators,” says Cline. “Many who were students in 1984 are world leaders in their fields today.

“Of the more than 5,000 professionals who have attended TRF conferences, many are now CEOs, presidents and deans of major universities around the world. Attendees also have become leaders in NSF, NIST, DARPA, ARPA-E, and NNSA.”



“The TRF mission has not been to ‘claim ownership’ of the microsystems field,” says Steve Senturia, “but rather to ‘promote’ the microsystem field in a variety of ways.”

The best-known TRF-sponsored meeting is the biennial [Workshop on Solid-State Sensors, Actuators, and Microsystems](#), popularly known as the “Hilton Head Workshop.” Since its inception in 1984, it has been held in Hilton Head, S.C.

TRF also sponsors worldwide topical and focused microsystems conferences, seminars, and short courses, such as [PowerMEMS](#), [Microtechnologies in Medicine and Biology Conference](#) (MMB), the [Transducers International Conference on Solid-State, Actuators, and Microsystems](#), and the [TRF Napa Microsystems Workshop](#).

The expansion of the transducers field, of TRF and of its conferences have tracked together. Cline writes, “The number of papers presented at TRF-sponsored meetings has grown from 50 in the early years to more than 1,000 at some conferences today. In 2002, commercial and manufacturing companies had five exhibit booths represent their businesses at the Hilton Head Workshop; in 2022, 38 companies exhibited and supported the Workshop.

“During this time, 5,646 participants attended the meeting, and 166 professionals have served on its technical program committees. There have been a total of 672 talks and 1,012 poster presentations.”



The worldwide community of researchers in solid-state sensors met in 1981 at a Boston symposium of the Materials Research Society. [Wen Ko](#) (1923–2018), professor at Case Western Reserve University, played a key organizing role. He later was the TRF President from 1994–2004.

Steve Senturia recalls, “After one of the technical sessions, there was a consensus to hold an extra evening session to discuss the future of the microsensors field. Everyone expressed frustration that microsensors work was always presented on the fringe of other conferences such as the Electrochemical Society Conference, the International Electron Devices Meeting, the Device Research Conference, and so on. Microsensors needed its own meeting.

“It was agreed to set up an international conference, to be called the [Transducers International Conference on Solid-State, Actuators and Microsystems](#) (Transducers), that would meet in the late spring of odd-numbered years. Researchers in each country were encouraged to create their own national meetings in even-numbered years.”

Kurt Petersen and Joseph Giachino recall that Transducers “was the place to present the latest research, development, and commercialization results work in solid state sensors, and later, actuators, microsensors, microactuators, MEMS and microsystems. It also was devoted to applications for this work in health-related fields and medical devices, transportation, environment and space, energy harvesting, communications, and a broad variety of consumer products.”

Senturia continues, “[Simon Middelhoek](#) (1931–2020) of Delft University in the Netherlands volunteered to host the first Transducers in 1983, with a planned rotation to the U.S., then to Asia, then back to Europe on a six-year cycle. An international steering committee was established at that time to coordinate the cycle of international conferences.”

However, there was a feeling the six-year cycle was “inadequate to meet the community’s needs in a growing field.” So a committee was formed to explore ways meetings could be held more frequently in the Western Hemisphere; perhaps every two years in even-numbered years.

According to Petersen and Giachino, “[Ken Wise](#), professor at the University of Michigan (now emeritus), initiated a meeting to address the best way to fill this void. Those present were: Wise; Wen Ko; Dave Eddy (1956–2023), GM; Ben Hocker, Honeywell Corporate Technology Center (now retired), who was the TRF President from 2010–2016; Tom Poteat (1935–2023), Bell Labs; Steve Senturia, MIT; and Joe Giachino, Ford. In addition, Scott Chang at GM supported the *Transaction* printing.”

“At first, the U.S. participants were not sure how to proceed,” Senturia says. “Wen Ko decided to incorporate a non-profit called the Transducer Research Foundation, with the mission of promoting research, communication, education, and mentoring workers in the solid-state transducers field. He had already set this up with an attorney in Ohio shortly after the 1981 MRS meeting. The Board of Trustees included Ken Wise, [Richard Muller](#) of UC Berkeley, Steve Senturia, and several others. This board served as a *de facto* organizing committee for what would come next.

“Steve Senturia and Richard Muller applied to the [Gordon Research Conferences](#) to set up a microsensors workshop for early 1984, but their proposal was turned down. The informal board, with Muller taking the lead, then made a proposal to the [IEEE Electron Devices Society](#) (EDS) to sponsor a meeting in June 1984, and it was accepted. This was the first [Workshop on Solid-State Sensors, Actuators, and Microsystems](#) (Hilton Head Workshop).



EDS went on to sponsor the first two Hilton Head Workshops in 1984 and 1986. However, early on a number of difficulties arose.

Senturia writes, “There was an issue of international attendance. IEEE was unhappy with the Hilton Head Workshop organizers’ policy of allowing only North American researchers to attend so that the meeting could be held more frequently.”

The committee members had anticipated this issue, and had pre-emptively asked their European and Asian colleagues how they felt about limiting Hilton Head attendance to participants from the Americas. As Petersen and Giachino recall, “Neither group objected to this idea. In fact, the Europeans started their own EUROSENSORS meeting with the intent of limiting attendance to Europeans. Because all parties were in concert, the EDS professional staff also had no objection.

“However, an EDS member in a position of authority objected on the basis that IEEE meetings had to be open to any and all IEEE members. If the workshop did not abide by these rules, there could be no IEEE support.

“Organizers also had hoped to secure IEEE financial, technical, archiving, and administrative support, but such support was not forthcoming.

“In addition, the organizers were not certain the EDS would approve of a workshop that had a limit on the total number of attendees and (at least in theory) attendance by invitation only.

Senturia concludes, “It was at this point that the organizers decided to separate from IEEE sponsorship and fund and run the Hilton Head meeting under TRF’s auspices. The organizers voted to accept the financial risk, and TRF became an operating foundation. With real risks and real responsibilities also came the ability to net real money in the bank. The mission going forward was to keep the Hilton Head meeting alive, and to operate it at such a level of excellence that people would throng to it. It worked.”

Since the inception of the early meeting in 1984 and evolving into the TRF Hilton Head Workshop, the TRF Board performed all the preparation and coordination of the entire meeting: call for abstracts, promotion, presenters, TPC meeting, proceedings (printed

from mailed-in mats), hotel negotiations and coordination, and the management of the actual meeting. This proved to be draining for these TRF Board volunteers, and Katharine Cline’s firm, Preferred Meeting Management, was hired to manage the details of the Hilton Head Workshop so the TRF Board Members could again focus on TRF, their careers, and networking during the meeting.

“Creating the TRF was a controversial and risky move at the time,” says Tom Kenny. But it was extremely successful at allowing the culture of the community, and especially the Hilton Head Workshop, to take shape and become established.”



The Hilton Head Workshop model is taken from the Gordon Research Conferences. There are no parallel breakout sessions; all sessions are plenaries with everyone in attendance. Lunches are included in the program so people can talk with each other and exchange ideas. There is a free afternoon to allow participants time to explore. Finally, the workshop features a “rump” session with refreshments and a very free flow of comments.

Tom Kenny writes: “To me, the culture is what stands out. I will never forget the first Hilton Head meeting I attended, in 1990, where I heard about the “rump session” to take place on Wednesday night. I found a smallish room, with a keg of beer in the back and a popcorn machine, an overhead projector, and a gathering of about 20 of the then-current leaders of the MEMS community.

“I watched Steve Senturia, Henry Guckel, and Richard Muller take turns presenting the latest data on the properties of the thin polysilicon being grown at MIT, UW and UCB, with the general idea that one of these three institutions would take over supplying polysilicon films to all the rest so we could make progress with a common base of key material. I sat in the back, sipping beer and munching popcorn while these pioneers had a lively, constructive discussion. I don’t remember that there was any particular conclusion, but it was clear that while there might normally have been fighting over supremacy in another technical community, these leaders were actually doing an amazing thing—seeking a broad collaboration that would serve them all.

“Earlier in the week, I’d seen some of these same people—clad in Hawaiian shirts, shorts, and sandals—give presentations and engage in discussions after students gave presentations in the same way. To me, a refugee from the low-temperature physics community (which included people fighting over things like high-temperature superconductivity and cold fusion), this was amazing, enticing, and wonderful. And this became my home. The culture of that meeting from more than 30 years ago persists to this day.

Petersen remembers, “The rump session comments that stay in my memory are ‘Single crystal bigots’ and ‘I agree with Professor Senturia.’ I do not know if our current attendees have any idea to what these quotes are referring.”

Kenny writes, “The culture is a big part of what differentiates this community from others. Technologically, I’ve always loved the embrace of new problems, and eagerness to use the tools of MEMS to solve them. For 40 years, TRF, the Hilton Head meetings, and the expanding collection of other TRF-sponsored events have combined quality meetings in nice places with a workshop culture of engagement.

“By continuing to welcome new people with ties to new applications, problems, and ideas and approaches, this community has never been particularly fussy about what belonged and what did not. It certainly embraces people who bring challenges and a positive, collaborative, can-do attitude. The early members of this community established the culture of encouragement and openness that persists today.”



The story of TRF’s evolution and workshops unfolds in its [technical digests](#).

Katharine Cline writes, “The prefaces in the technical digests created from 1984 to 2022 have the common theme of addressing sensors in the scheme of solid-state electronics, then growing to the successful application of microelectronics in health care, transportation, and automated manufacturing.

“TRF, The Hilton Head Workshop, and the other meetings TRF sponsors are designed to create collaborations through connections. These meetings increase and strengthen a global community of professionals, stimulating research in science and engineering. They

foster the exchange of ideas and information between academic, industrial, and government researchers.

“In the preface to the first Hilton Head Workshop in 1984, Ken Wise wrote: ‘This meeting continues today to create informal interactions among professionals in the sensor field—sharing ideas, debating approaches, and simply getting better acquainted.’ The most important mission of TRF is to create a community of professionals that can accomplish this exact 1984 statement.”

A confluence of circumstances led to Hilton Head being chosen as the permanent location for the Workshop.

Petersen and Giachino recall: “The group decided that the workshop would work best in a resort-type location with a casual, laid back atmosphere that would encourage people to informally interact. There were many suggestions for the venue, including Mackinac Island, Mich., and Sandusky, Ohio.

“Tom Poteat suggested Hilton Head, S.C. None of the other attendees knew of Hilton Head. Tom had grown up in the area and filled us in on the history and status of this barrier island. In the early days it was a place locals took their pigs to spend the winter. The pigs could forage for food but they could not leave the island. In the 1960s, developers started to turn the island into an upscale resort community.

“The group was concerned about how accessible the island would be to people coming in from around the country. Tom let us know that the island was easily reached from Savannah, Ga., and that the island even had a small airport, with shuttle service, if one did not want to drive.

“Members of the group all had been previously involved in conference management and understood the effort involved in the tasks required for a successful meeting. So when Tom said, ‘If you select Hilton Head I will be the local arrangements chair,’ the group selected Hilton Head. After the first workshop, the suggestion was made that, like many IEEE meetings, we alternate between east coast and west coast. The suggestion was made that the meeting next be held in Monterey, Calif. The group agreed that was a good location and the question was asked, ‘Who would like to be the local arrangements chair?’

“Thus was born the Hilton Head Workshop.”



Recently, the TRF under TRF President Reza Ghodssi made a decision to open up the Hilton Head Workshop program to abstracts submitted from other regions, building the global community of professionals. This has led to the Hilton Head Workshop providing a more international forum for North, South and Central American researchers.

Ghodssi notes, “As a community born out of a desire to represent a diverse and interdisciplinary device community in North America, we are now coming full circle by recognizing TRF’s global impact and influence. While the base of both entities remains in the U.S., we have become a more inclusive international research and educational organization, and Hilton Head is now an international workshop.

The technical program is driven by abstract submissions in new concepts in sensors, actuators, and microsystems; design and modeling methodologies for device and processes; fabrication techniques including all aspects of microfabrication, materials and methods of processing; circuits for sensors, actuators and system implementations; and packaging and testing, including data analysis for device and systems interfaced to the application environment.

The most recent Hilton Head workshop was held June 5–9, 2022. Our 2020 Workshop was held entirely online due to the COVID-19 pandemic. An interesting article about the history of the workshop is available [here](#).

“Hilton Head has been one of the incubators of new and self-sustaining technical areas in MEMS and microsystems,” Ghodssi says. “As president, I have encouraged the current leaders of this thriving, relevant workshop to continue to reach out to researchers pursuing new areas. That is why we have been promoting Grand Challenges work that could one day impact society at large in our keynote talks and new focused topical workshops.”

TRF has sponsored and co-sponsored such meetings as the IEEE Transducers Conference, the CBMS Micro-TAS Conference, the Inertial Sensors Conference, the TRF Napa Workshops, Intelligence and National Security (INSS) Conferences, and both the PowerMEMS

and MMB Workshops. These meetings have reached the professional communities to bring together Ph.D. students to present their research.

Ghodssi says, “We have been careful to stay committed to our original mission of promoting mentoring, networking and outreach for students and young colleagues in the conferences and meetings we sponsor. I believe this is how we move forward.”

Senturia writes, “TRF was on the ground before other sensor and MEMS communities. Although the others also support research and education, TRF focuses specifically on career development, encouraging student and postdoc participation in its meetings, with an intensive research focus.”

“I have noticed others’ meetings focus more on commercialization,” he says. “People can now make money in MEMS. There are billion-unit markets for devices. The challenge for TRF is to remain at the forefront and sponsor ‘must-attend’ events for both academic researchers and industrial and commercial pioneers.”

“The issue of future community Grand Challenges is tough, important, and on the agenda at every Hilton Head meeting,” Kenny writes. “Medicine, global

health, energy, and the health of the planet are just some of the topics on which we need to provide input. I look forward to the discussions we will have.”

“TRF can expand its scholarship programs and relationship with manufacturing companies to support master level, undergraduate, and high school programs in lesser-known academic institutions to create future interest into transducers, microsystems, and nanosystems,” Cline believes. “This will also create a broader base and diverse audience. Because TRF is not a huge bureaucratic organization, it has the ability to address issues when and as they surface.”

Ghodssi concludes, “MEMS devices and systems play vital roles in our everyday lives, from health care to environmental monitoring, to autonomous systems, to space exploration, to energy efficient devices, and we can no longer ignore the essential benefits they provide to humanity.

“I agree with my colleague Mark Allen that ‘MEMS is now a quiet revolution.’ Now, with the emergence of AI, machine learning and data analytics, we envision our device community will be even more impactful in every segment of society in years to come.”

<https://www.transducer-research-foundation.org/>