This session presents recent advances in sensor interfaces for MEMS as well as temperature sensors. The papers span industrial and academic contributions. They exceed industry standard specifications and reveal innovative solutions. The first 4 papers describe capacitive sensor interfaces that bias MEMS microphones, compensate package-related offset, advance precision-displacement sensing, and address sustainability in harsh environments. The last 4 papers describe temperature sensors, which are becoming ubiquitous parts of integrated systems. The papers set new records in temperature range, accuracy, power efficiency, and level of integration by introducing new architectures, advances in technology, and circuit-level innovation.

11.1  A ΔΣ Interface for MEMS Accelerometers Using Electrostatic Spring-Constant Modulation for Cancellation of Bondwire Capactiance Drift

P. Lajevardi, Stanford University, Stanford, CA

In Paper 11.1, Stanford University (with Robert Bosch) presents a method to measure and null the offset due to the asymmetry and drift of the parasitic capacitances of the bond wires connecting a MEMS accelerometer and its CMOS interface circuit. The technique reduces bond wire offset by 41dB, to 6.24mg.

11.2  A Capacitance-to-Digital Converter for Displacement Sensing with 17b Resolution and 20μs Conversion Time

S. Xia, Delft University of Technology, Delft, The Netherlands

In Paper 11.2, Delft University of Technology describes a capacitance-to-digital converter with 17b resolution for precision displacement-sensing applications. The converter digitizes a 10pF off-chip capacitance with a resolution of 74aF_{rms} in a conversion time of 20μs.

11.3  A 50μW Biasing Feedback Loop with 6ms Settling Time for a MEMS Microphone with Digital Output

J. van den Boom, NXP Semiconductors, Nijmegen, The Netherlands

In Paper 11.3, NXP Semiconductors proposes a digitally assisted biasing scheme for a MEMS microphone. It compensates for bidirectional leakage currents of up to 1pA. The achieved noise level is less than -90dBFS, while its 6ms settling time is quite low and facilitates industrial testability.
11.4 ASIC for a Resonant Wireless Pressure-Sensing System for Harsh Environments Achieving ±2% Error Between -40 and 150°C Using Q-Based Temperature Compensation

M. Rocznik, Robert Bosch, Palo Alto, CA

In Paper 11.4, Robert Bosch proposes a wireless pressure sensor for harsh automotive environments. The system uses resonant coupling between a sealed capacitive pressure sensor and a readout ASIC to protect the latter from potentially corrosive gases. The system achieves ±2% error between -40 and 150°C using Q-based temperature compensation and a 1kS/s readout rate.

11.5 A ±0.4°C (3σ) -70 to 200°C Time-Domain Temperature Sensor Based on Heat Diffusion in Si and SiO₂

C. van Vroonhoven, Delft University of Technology, Delft, The Netherlands

In Paper 11.5, Delft University of Technology (with National Semiconductor) presents a temperature sensor based on the well-defined rate of heat diffusion in silicon. It achieves ±0.4°C inaccuracy over an extremely wide temperature range of -70 to +200°C. The sensor is fully self-contained and does not require an accurate external time reference.

11.6 A Temperature-to-Digital Converter for a MEMS-Based Programmable Oscillator with Better Than ±0.5ppm Frequency Stability

M. Perrott, Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates

In Paper 11.6, SiTime (with Fairchild Semiconductor, and University of California, Los Angeles) describes the first use of a thermistor-based temperature sensor to stabilize a MEMS frequency reference. The resulting system achieves a frequency stability of <0.5ppm over the industrial temperature range, which is the best reported performance for a MEMS frequency reference.

11.7 A CMOS Temperature Sensor with a Voltage-Calibrated Inaccuracy of ±0.15°C (3σ) From -55 to 125°C

K. Souri, Delft University of Technology, Delft, The Netherlands

In Paper 11.7, Delft University of Technology proposes a voltage-calibration scheme for a deep-submicron CMOS temperature sensor. After calibration, the sensor achieves an inaccuracy of ±0.15°C from -55 to 125°C, and is the most energy-efficient BJT-based temperature sensor ever reported.

11.8 Ratiometric BJT-Based Thermal Sensor in 32nm and 22nm Technologies

J. Shor, Intel, Yakum, Israel

In Paper 11.8, Intel demonstrates that BJT-based temperature sensors can reliably be realized in highly scaled 32 and 22nm technologies. Not only are the resulting sensors some of the smallest ever reported, their 10-to-100μs conversion times make them fast enough for hot-spot monitoring in multi-core microprocessors.