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Andreas Spanias, IEEE Life Fellow, Arizona State University

Lecture title:

Transform Coders for Speech and Audio Signals - Classical and Quantum Realizations

Signal analysis-synthesis and compression using transform models is a powerful technique for low bit-rate speech and audio signal representation. The basic ideas go back to the 1970s with more sophisticated models proposed later in the 1980s and speech transform-based compression standards established in the 1990s. These signal representation models rely on mean square minimization and peak picking and utilize spectral envelopes and phase models to reduce bit rates in speech coding applications. Later on sinusoidal models for speech that are based on harmonic structures were presented and in the 2000s we have selection of sinusoids based on psychoacoustics. More recently in 2023 at Arizona State, we developed transform models for speech analysis-synthesis based on the quantum Fourier transform (QFT). These QFT-based signal analysis-synthesis models were simulated in IBM Qiskit and compared with classical computing implementations. In the seminar, we will discuss these models and present both classical and QFT-based representations and comparative results. The effects of quantum noise on signal reconstruction will also be described. The seminar will close with a brief presentation of various other research projects and activities at the ASU SenSIP center in an effort to determine areas for collaboration.



Andreas Spanias



Social gathering after the lecture

Andreas Spanias is Professor in the School of Electrical, Computer, and Energy Engineering (ECEE) at Arizona State University (ASU). He is also the director of the Sensor Signal and Information Processing (SenSIP) center and the founder of the SenSIP industry consortium (established as an NSF I/UCRC site). His research interests are in the areas of AI, adaptive signal processing, speech processing, quantum machine learning and sensor systems. He and his students developed the award winning software J-DSP which was sponsored by NSF. Dr. Spanias is author of two textbooks: Audio Processing and Coding by Wiley and DSP; An Interactive Approach (2nd Ed.). He contributed to more than 350 papers, 11 monographs, and 26 US patents. He served as Associate Editor of the IEEE Transactions on Signal Processing and as General Co-chair of IEEE ICASSP-99. He also served as the IEEE Signal Processing Vice-President for Conferences. Andreas Spanias is co-recipient of the 2002 IEEE Donald G. Fink paper prize award and was elected Fellow of the IEEE in 2003. He served as Distinguished Lecturer for the IEEE Signal Processing society (SPS). He is currently heading four NSF workforce development projects as a PI. He received the 2018 IEEE Phoenix Chapter award with citation: "For significant innovations and patents in signal processing for sensor systems." He also received the 2018 IEEE Region 6 Outstanding Educator Award (across 12 states) with citation: "For outstanding research and education contributions in signal processing." He is a Senior Member of the National Academy of Inventors (NAI). He was recently selected for a Fulbright Research Scholar award with residence in Spring 2025 at the Ss. Cyril and Methodius University (UKIM) FEEIT. During this period Prof. Spanias will also deliver regional research seminars in several countries in the Balkans and in the Eastern Mediterranean.