# Mahmut Semih Akkoç

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ECE Ph.D. student at the University of Maryland (advisor: Prof. Sennur Ulukus) working at the intersection of **information theory**, **data compression**, and **LLM interpretability**: deriving rate–distortion limits for task-aware compression and analyzing transformers as tractable dynamical systems. Four papers in year one. Seeking a **Summer 2027 research internship** in efficient AI, compression, or interpretability.

## Education

**University of Maryland, College Park** — Ph.D., Electrical and Computer Engineering *Sep. 2025 – Aug. 2030 (Expected)*
GPA: 3.93/4.00 | Advisor: Prof. Sennur Ulukus | Focus: Information Theory, Interpretability of LLMs

**Bilkent University** — B.Sc., Electrical and Electronics Engineering *May 2025*
GPA: 3.92/4.00 | Exchange semester at the National University of Singapore, Singapore (2024)

## Experience

**Graduate Research Assistant, University of Maryland** College Park, MD
*Information Theory & Machine Learning* *Sep. 2025 – Present*

- Introduced *deception* as a third axis of rate–distortion–perception theory and derived the achievable tradeoff region, bounding how far a lossy codec can steer output statistics — applicable to generative-model watermarking, output auditing, and privacy-preserving compression.
- Proved that depth-wise dynamics of deep linear transformers reduce exactly to a generalized Kuramoto model in embedding dimension two, giving a closed-form, interpretable surrogate for stacked self-attention and mechanistic criteria for when depth compresses versus destabilizes representations.
- Delivered **one accepted conference paper, one journal submission under review, and two manuscripts in preparation in year one**, collaborating across four institutions (UMD, UW–Madison, Oxford, Ohio State).

**Undergraduate Researcher, Bilkent University** Ankara, Türkiye
*Semantic Signal Processing — Prof. Orhan Arıkan* *Feb. 2023 – May 2025*

- Built the embedded multi-sensor demonstrator that turned the group's semantic signal processing theory into a working system, establishing the experimental basis for a first-authored journal publication.
- Profiled semantic extraction under strict power and memory budgets on Raspberry Pi, quantifying the compute floor for real-time goal-oriented inference at the edge.

**R&D Intern, Huawei** Ankara, Türkiye
*Semantic Communications* *Jun. 2023 – Aug. 2023*

- Prototyped a two-node semantic communication network performing visual semantic extraction entirely on-device, collapsing transmission from a 10 Mbps raw video stream to ∼10 bps of task-relevant tokens — a $\sim 10^5\times$ bandwidth reduction achieved by transmitting meaning rather than pixels.
- Engineered the TCP transport layer and a stream fusion algorithm merging asynchronous multi-sensor inputs, improving integration accuracy by 67.2% over unfused processing within embedded power and memory limits.

**Summer Intern, ASELSAN** Ankara, Türkiye
*RF & Microwave Systems* *Aug. 2024 – Sep. 2024*

- Designed a suspended ring resonator model in MATLAB and CST Studio estimating dielectric constant and loss tangent — a low-cost alternative to commercial material characterization — generalized via lookup tables and polynomial fits to transfer across materials.

**Summer Intern, BİTES Defence & Aerospace** Ankara, Türkiye
*Software Engineering* *Jun. 2022 – Aug. 2022*

- Built a multithreaded, socket-based file transfer system in C++ supporting arbitrary file types via binary-mode I/O, using factory and observer patterns to keep socket creation and worker notification decoupled.

## Selected Publications

Full record: Google Scholar. † equal contribution.

- **S. Akkoc**, S. Liyanaarachchi, S. Ulukus, and A. Yener, "The Rate–Distortion–Deception Tradeoff," *Proc. 62nd Allerton Conf. on Communication, Control, and Computing*, 2026.
- **S. Akkoc**†, A. Çınar†, B. Ercan†, M. Kalfa, and O. Arıkan, "Practical Hardware Demonstration of a Multi-Sensor Goal-Oriented Semantic Signal Processing and Communications Network," *Journal of the Franklin Institute*, vol. 362, no. 1, 2024.
- S. Li, T. J. Maranzatto, J. Peszek, T. Teolis, **S. Akkoc**, K. Riedl, S. Ulukus, and N. García Trillos, "On the Diverse Dynamical Behaviors Arising in Deep Linear Transformers," under review at *Foundations of Computational Mathematics*, 2026.
- S. Liyanaarachchi, **S. Akkoc**, S. Ulukus, and A. Yener, "Task-aware Compression with Distribution Matching," submitted to ICLR 2027.
- T. J. Maranzatto, **S. Akkoc**, and S. Ulukus, "The Role of Feed-Forward Layers in Transformer Dynamics," submitted to AISTATS 2027.

## Technical Skills

- **Theory:** Information Theory, Rate–Distortion(–Perception), Lossy & Task-Aware Compression, Mechanistic Interpretability, Dynamical Systems, Probability & Stochastic Processes, Optimization
- **Programming:** Python, C++, MATLAB, VHDL, LaTeX | **Tools:** PyTorch, NumPy/SciPy, Matplotlib, Git, CST Studio
- **Awards:** Academic Excellence and Research Excellence Awards, Bilkent EEE (2025); Best Project Award, Bilkent Physics (2022)
- **Languages:** Turkish (native), English (fluent)