The Visual System: From the Lab to the Wild

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Abstract

Human vision operates within a visual world that is structured, dynamic, and statistically complex, yet much of our current understanding derives from controlled laboratory settings that only partially reflect this complexity. This talk explores the relationship between the human visual system and the statistical properties of natural visual environments, highlighting subtle but pervasive adaptations and arguing that a rigorous characterization of the visual environment remains a fundamental, and still incomplete, step toward understanding visual physiology, performance, and behavior.

I will discuss recent advances in technologies and methodologies that enable the measurement and characterization of visual input beyond the laboratory, including challenges in acquisition, calibration, comfort, and ecological validity. Building on these developments, I will present experimental paradigms and data-processing pipelines aimed at extracting comprehensive statistical descriptions of visual scenes. These statistics enable direct comparisons with the properties of the human visual system, revealing signatures of adaptation and optimization and clarifying what vision is tuned to process and why it functions as it does.

Finally, I will address the implications of this perspective for both basic science and applied domains. Understanding vision in its natural statistical context informs models of visual processing, guides the design of experiments, and has practical consequences for virtual and augmented reality systems, as well as for clinical assessment and rehabilitation. By moving from the lab into the wild, this work aims to bridge controlled vision science with real-world visual experience.

Biography

Agostino Gibaldi is a bioengineer who began his research on bio-inspired computational models of the early visual system for robotic vision. He later transitioned to vision science, quickly learning how obtaining reliable and explanatory data from human observers is considerably more challenging than from robots. His current work focuses on understanding the interplay between natural visual environments and human visual perception, examining how perception is shaped and operates in real-world conditions. His research approach combines engineering expertise with vision science to design and implement technological tools for measuring visual environments in ways that are accurate, reliable, comprehensive and (sometimes) comfortable way. His current research focuses on the role of the visual environment in binocular visual dysfunctions and myopia progression, thus tackling both how vision fails and how the visual world may be partly to blame.