

Improving sustainability through dedicated AI hardware and creating systems of systems

About

Dr Wim Melis' research bridges two significant fields: developing energy-efficient AI hardware and combining systems for improved sustainability. His work addresses limitations in current computer hardware for AI applications and explores how renewable energy systems can better work together for improved overall efficiency, delivering smarter buildings and supporting communities. Through innovative approaches, Wim optimises for energy use, enhances system reliability and fosters community involvement in sustainable solutions.



Work

Wim's primary research focuses on designing computer architectures that are better aimed at delivering intelligent solutions and therefore more suitable for AI applications. Traditional hardware systems are energy-intensive and inefficient for AI. For example, a ChatGPT query consumes between five and twenty-five times the power of a typical Google search. This inefficiency highlights the urgent need for more dedicated hardware.

To overcome these limitations, Wim's team have developed novel computing techniques which they tested in an electronic and optical context. One key breakthrough demonstrated the real-time optical recognition of objects with significantly reduced power consumption, a potentially transformative technology for applications like autonomous vehicles. Additionally, this new technology is adaptable across a range of other applications, including e.g. cochlear implants.

Wim also engages in "systems of systems" research, particularly towards optimising renewable energy systems, energy storage and building efficiency. This includes designing systems that combine different renewable energy systems with various storage solutions. In a subset of this work, Wim supervises projects focused on improving energy efficiency in heritage buildings through Life Cycle Assessment and Digital Twin technologies. By leveraging Machine Learning models, his team can analyse and enhance energy use within older buildings, while maintaining historical integrity and achieving modern efficiency standards.

Wim collaborates with local councils to educate communities on effective retrofitting methods. His public engagement emphasises understanding building fabric, building materials, improving thermal efficiency and creating smart homes for better health and energy savings. These community-based projects extend to retrofitting heritage properties for communal use, creating a shared sense of ownership and environmental responsibility.

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