

COGNITIVE AGEING MODELLING AND CHARACTERIZATION

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Research Group: Telematics Systems Engineering Group

The Telematics Systems Engineering Group (GIST) explores the convergence of artificial intelligence, cognitive ageing modelling, and privacy-preserving distributed ledger technologies to design next-generation intelligent systems that are adaptive, secure and inclusive, spanning multiple application fields. Group activities involve the development of AI-driven platforms capable of personalizing experiences based on dynamically inferred cognitive profiles and trajectories, enabling tailored interventions for diverse populations, including older adults. At the same time, the group investigates how decentralized ledger technologies and advanced cryptographic methods can ensure the secure management of data and identities, preserve privacy while enable trust, transparency, and interoperability across systems. The work spans machine learning for longitudinal user modelling, human-centered adaptive system design, and secure distributed infrastructures, with the goal of creating robust, privacy-aware ecosystems.

Keywords: Cognitive ageing trajectories | Longitudinal machine learning | Multimodal ageing markers | Early cognitive decline detection | Interpretable health

Research Focus:

Developing computational and machine learning approaches to understand how cognitive abilities evolve across the lifespan and how different patterns of ageing emerge among individuals. The research aims to model longitudinal cognitive trajectories using heterogeneous data sources such as neuropsychological assessments, neuroimaging, genetic information, lifestyle indicators, and digital behavioral signals. Methods: statistical learning, representation learning, temporal modelling. Goal: to identify latent cognitive ageing profiles, detect early markers of atypical decline, and distinguish normal ageing from preclinical neurodegenerative processes. Particular emphasis is placed on interpretable and robust models that can handle incomplete and irregular longitudinal data while providing meaningful insights. The outcomes of this research may contribute to improved early risk stratification, better understanding of resilience and vulnerability factors in ageing, and the development of data-driven tools to support personalized monitoring and screening strategies.