



TITAN: Advancing Astrophysical Data Analysis through Computational Intelligence

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ABSTRACT

The [TITAN ERA chair project](#) focuses on addressing the immense challenges presented by the era of big data in astrophysics, driven by the massive datasets generated by advanced telescopes and simulations. These datasets, which are highly complex and multi-dimensional, require advanced computational methods for effective processing and analysis. TITAN aims to revolutionize the field by developing machine learning (ML) techniques that not only integrate physical laws but also provide reliable estimates of uncertainty and address noise and missing data.

By building on robust foundations in astroinformatics, TITAN combines advanced data science, ML, and astrophysical research to overcome traditional limitations. Key innovations include the development of frugal and trustworthy AI models designed to handle massive high-dimensional data sets efficiently, with reduced computational demands, supporting distributed processing across space mission data. Furthermore, TITAN introduces cutting-edge techniques in inverse problems and deep learning, emphasizing reducing noise while retaining theoretical guarantees of accuracy and generalization.

The TITAN project is a joint project between the Institute of Computer Science, the Institute of Astrophysics of FORTH, and the Astrophysics Department at CEA Saclay. The project's interdisciplinary nature extends its application beyond astrophysics, with tools and models also applied in fields such as Earth observation and neuroscience. TITAN's methods for handling high-dimensional, multimodal data offer solutions to challenges in these disciplines, showcasing the project's adaptability and broad scientific relevance.

In addition to scientific research, TITAN contributes to capacity-building through education and training initiatives, preparing young researchers with the skills necessary to lead future scientific progress in data-driven fields. The project emphasizes sustainability by forging industry partnerships and creating innovative solutions that are resource-efficient and adaptable to various scientific applications.