

Modelling, Simulation and Observation in Space Research The field of space science exploration relies heavily on the interconnectedness of modelling, simulation, and observation, forming a dynamic cycle that continually enhances our understanding of the cosmos. In the realm of modelling, theoretical approaches, such as physics-based explanations provide foundational frameworks for comprehending celestial phenomena. Additionally, Artificial Intelligence and Machine Learning-based modelling, driven by Big Data Analytics (usage of huge amount of data pertaining to a physical phenomenon or any aspect of a celestial body to find a pattern in them), has emerged as a powerful tool for extracting patterns and insights from vast datasets, offering a complementary perspective. Simulation, a crucial component, encompasses both computer and laboratory simulations. Computer simulations digitally replicate complex space scenarios, aiding in the prediction of celestial events and the behaviour of astronomical objects. Laboratory simulations, on the other hand, recreate space conditions pertinent to specific studies, providing controlled environments for in-depth analysis. Observation plays a pivotal role, encompassing both space-based and ground-based methodologies. Space telescopes and observatories offer unique vantage points for unobstructed views, while ground-based observatories contribute to a comprehensive understanding of the