# Advancing 3D Scene Reconstruction: Techniques, Pipelines, and Applications—Popular Science

In recent years, AI has made significant progress in Natural Language Processing, Decision Making, and Environment Understanding. To endow AI with the ability to perceive and comprehend information from complex scenes in a manner of human vision, Computer Vision plays an important role in interpreting 3D information out of 2D images.

3D reconstruction is a technology that creates three-dimensional digital models of real-world objects or scenes. As a vital branch of Computer Vision, it has applications in various fields, including entertainment, education, and industry. This thesis explores the most advanced methods for 3D reconstruction and their potential uses.

One of the key challenges in 3D reconstruction is capturing accurate data from different camera setups. The thesis investigates both static and dynamic camera setups, each with its own advantages and disadvantages. Static cameras are fixed in position and offer stability, while dynamic cameras move around the object to capture multiple angles. The thesis explores how to combine the strengths of both setups to achieve robust and flexible data acquisition.

This thesis also delves into the technical aspects of 3D reconstruction, including camera calibration, image segmentation, and model training. Camera calibration is the process of determining the camera's settings, like focal length and distortion, to ensure accurate 3D models. Image segmentation involves separating the object of interest from the background, which is crucial when using static cameras. Model training uses machine learning algorithms to learn the relationship between 2D images and 3D structures, enabling the reconstruction of new objects. We evaluate different reconstruction algorithms, such as Instant Neural Graphics Primitives (Instant-NGP), 3D Gaussian Splatting (3DGS), and Neural Implicit Surfaces (NeuS), to determine their effectiveness in handling complex object geometries and motion dynamics.

The potential applications of 3D reconstruction are vast. In the entertainment industry, it can be used to create realistic digital assets for games and virtual experiences. In education, it can provide interactive models for students to explore historical artifacts or complex machinery. In industry, it can enhance training simulations for tasks like industrial maintenance or medical procedures.

Overall, this thesis contributes to the understanding and advancement of 3D scene reconstruction techniques, highlighting their potential to revolutionize various industries and improve our daily lives.