

# SURGICAL TOOL TRACKING USING AUGMENTED REALITY AND INFRARED MARKERS - A COMPARATIVE STUDY

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**doi:10.34107/UKKK6693.091**

## ABSTRACT

Augmented Reality (AR) based tool tracking is rapidly gaining prominence in the medical field, particularly in the domain of surgical tool tracking. This computerized navigation system contributes to the enhanced precision of placing invasive surgical tools during procedures. This paper aims to provide a comparative analysis between two tracking methods: stereo camera-marker-based tool tracking and Optitrack IR marker-based tracking. The primary focus is on evaluating the precision and accuracy of tool movement in two dimensions. In this proposed system, AR Camera tracking is implemented using image targets, while Optitrack relies on an IR camera for tracking. The outcomes of these two tracking approaches are systematically compared with the aid of distance metrics. This scale serves as a quantitative measure, facilitating the analysis and comparison of the precision and accuracy of tool movements.

**Keywords:** Augmented Reality, OptiTrack, Infrared (IR) markers, Tool Tracking, Image Target, Distance metrics.

## INTRODUCTION

In the contemporary era, surgeons consistently seek out technological advancements to improve their surgical settings. They frequently embrace new technologies that enhance the overall surgical and patient experience, some of the examples are robotic surgery, surgeries utilizing augmented reality (AR) and virtual reality (VR) [1]. Although these innovations were initially expensive, their costs have decreased and availability has risen significantly over the past decade. Additionally, smartphones, now widely used and possessing micro processing capabilities comparable to desktop computers, have become commonplace among doctors, fostering an increased integration of technology in healthcare [2]. The paper presents a new approach to surgical tool tracking by employing Augmented Reality (AR) technology. Here Augmented Reality (AR) has made it possible to employ real and virtual world interactions during complicated surgical procedures [3]. In the past decade, integrating augmented reality and the computer assisted navigation systems, has been considered often for supporting surgeons during various surgical interventions. The core of the AR support system lies in tool tracking within the virtual surgical environment, often accomplished using a stereo camera for 3D positioning and tracking, while in certain instances, Infrared (IR) markers, using OptiTrack technology, are employed for tool tracking [4-6]. OptiTrack, originally designed for motion tracking, is gradually finding its way into medical applications. Here in this paper, the methodology involves the integration of marker-based tool tracking methods. That is by using Visual Markers and Infrared (IR) markers. In the Visual Markers method, the AR system's cameras identify and monitor these markers, enabling precise localization of surgical tools. Specifically, the Hairo marker is employed in this study, and the AR system, powered by