

# Microsoft Kinect and IMU Devices operation characteristics and their limitation compensation method.

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**Abstract.** Microsoft Kinect v.1 and inertial measurement units became very popular devices nowadays that allow to detect and track human motion for home users. Due to their operating characteristics both of these devices are fine for casual scenarios where precision is not crucial factor. In the following article, review of characteristics verified by experiments of both devices were presented as well as proposition of their limitations compensation method has been presented.

## 1 Introduction

Since Microsoft Kinect has been released in 2010 and inertial devices became integral and almost mandatory part of every smartphone, motion tracking and motion detection became very popular and easily available for home usage. Kinect is used mainly in the field that it was created for – games. However, due to the limitations, mainly caused by the way it is built, only relatively simple casual games has been developed for this controller. On the other hand, Microsoft Kinect became popular subject for researchers who wants to find how this device might be used in more advanced scenarios. The second of the mentioned devices – inertial measurement units (IMU) – can be easily find in almost every modern smartphone. From home user point of view, the most visible functionality implemented thanks to these devices is screen rotation. Also all applications that measures number of pedestrian's walks basing on them. Of course these devices also has some flaws and limitations that need to be taken into consideration in order to achieve accurate and stable results. In further part of this article measurement and working characteristics of both devices has been described as well as proposition of method how to compensate their limitations.

## 2 Kinect characteristics

Microsoft Kinect version 1 is a RGB-D camera built from two CMOS cameras and integrated infrared (IR) projector. One of these CMOS is responsible for RGB signal and the second one is calibrated to record IR beam's view. However,

the most important part is the main chip created by PrimeSense company which is responsible for motion tracking and gesture recognition. The simplified device build schema is visible in figure 1. According to official specification, operation range of Kinect is between  $0.8m$  and  $4m$  in the field of view  $57^\circ$  horizontally (static) and  $43^\circ$  vertically (adjustable  $\pm 21^\circ$ ). the same specification doesn't include any information about possible variety of measurements in this area. The range defined in official specification is presented in figure 3. However, some users [?] and researchers [?] observed that different device series have a slightly different ranges where they operate so above values should be treated as average values. Important characteristic of Microsoft Kinect – object distance measurement – is directly related to the device design and used algorithm (some form of structured light idea). Microsoft hasn't published any document how the algorithm actually works but basing on original patent forms [?, ?, ?] and independent research some rough description can be created [?] as well as used light pattern (fig. 2).

**Fig. 1.** Simplified Microsoft Kinect v.1 controler build schema [?]

**Fig. 2.** IR scene lighting pattern[?]

### 3 IMU characteristics

placeholder

### 4 Experiments & Compensation

placeholder

Range

$9m$

$8m$

$4m$

$0.8m$   
 $0.4m$

## 5 Summary

placeholder

## References