Mathematical Basics

The recognition of gestures is based on measured acceleration values. These values depend, as it was already depicted in section \ref{sect:dataModel}, on the orientation of the smartphone. The mathematical relation of the measured acceleration values and the smartphone’s orientation will be derived in this chapter. At first, the impact the smartphone being rotated along one of its axes is investigated in isolation. Afterwards, the results are combined and the final equation for each of the acceleration values is set up.

Terminology of the possible Rotations

There exist three different possible rotations that are measured by the gyroscope sensor:

\begin{itemize}

\item{

\textbf{Pitch} \newline

The angle of a rotation around the x-axis is called pitch. In the following equations, $\alpha$ will be used to describe the value of pitch that is retrieved from the gyroscope.

}

\item{

\textbf{Roll} \newline

The angle of a rotation around the y-axis is called roll. In the following equations, $\beta$ will be used to describe the value of roll that is retrieved from the gyroscope.

}

\item{

\textbf{Azimuth} \newline

The angle of a rotation around the z-axis is called azimuth. In the following equations, $\gamma$ will be used to describe the value of azimuth that is retrieved from the gyroscope.

}

\end{itemize}

**\subsection**{Acceleration depending on Pitch}

The current section investigates the effect of a rotation around the

smartphone's x-axis on the measured acceleration values. Figures

**\ref**{fig:yPitch} and **\ref**{fig:zPitch} show how accelerations in the direction of

x and of z respectively might be decomposed into the different

acceleration vectors that are parallel to the smartphone's axes. The

magnitudes of these vectors are measured by the smartphone's acceleration

sensor.

**\subsection**{Acceleration depending on Roll}

A rotation around a certain axis affects the measured acceleration values of the axes that are parallel to axis of rotation. Therefore, if the smartphone is rotated around its y-axis, the accelerations in the direction of x and z have to be investigated. The composition of the acceleration vectors can be retrieved from the figures \ref{fig:xRoll} and \ref{fig:zRoll}.

**\subsection**{Acceleration depending on Azimuth}