



Figure 3. Definition of Coordinate System and Rotation Axes

In addition, since this document is concerned with measuring orientation in the earth's gravitational field, the convention will be adopted that the accelerometer output is negated to give value $+1g$ in any axis aligned with the earth's downward gravitational field.

With this assumption, a three-axis accelerometer mounted in a smartphone oriented in the earth's gravitational field \mathbf{g} and undergoing linear acceleration \mathbf{a}_r measured in the earth's reference frame r , will have output \mathbf{G}_p given by:

$$\mathbf{G}_p = \begin{pmatrix} G_{px} \\ G_{py} \\ G_{pz} \end{pmatrix} = \mathbf{R}(\mathbf{g} - \mathbf{a}_r) \quad \text{Eqn. 1}$$

where \mathbf{R} is the rotation matrix describing the orientation of the smartphone relative to the earth's coordinate frame.