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Neutral directions for the normal gravity vector

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A neutral direction in a gravity field is a direction along which the coordinates of the gravity vector they do not change locally. This research will focus on the neutral directions for the normal gravity vector. The necessary condition for the existence of neutral directions at an arbitrary point P above the ellipsoid is the determinant of the Eötvös matrix which must be equal to zero. We will also show that the existence of such directions at that point depends on the values of principal curvatures. The slope of these directions depends on the value of a principal curvature and the curvature of the plumbline. In some cases the slope also depends on the value of the plumbline curvature or on the magnitude of the normal gravity vector. In all cases the neutral directions are on the meridian plane at point P. A very interesting case is when the point P (which lyes on the equipotential surface with normal potential UP) is a parabolic one, i.e. the curvature along the north-south direction is zero. In this case the neutral direction coincides with a principal direction on the tangent plane or it is a bisector of the local Cartesian system. A special case will be described which is the existence of infinite number of neutral directions at point P, all lye on the meridian plane. In addition it will be shown that due to the rotational symmetry of the normal gravity field there exist special neutral subsets of the three dimensional space. These subsets are neutral cones and neutral tori. Finally for further analysis a number of interesting figures will be provided for each case.