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Spanner Surfaces, an application to the normal gravity field

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In everyday life we use several instruments for example a knife, a pair of scissors, or a screwdriver to make some jobs easier to be done. The essence of this idea can be applied to mathematics - i.e. to introduce "useful geometrical instruments" - so that to solve various problems. In this presentation we will introduce the term "spanner surface". The term is based on the well known tool called "spanner". A spanner surface SS related to a surface S is a surface such that quantities of the surface S (components of surface vectors, vertical vectors, curvatures etc) can be expressed with the quantities of SS. The problem which we are going to solve is the following

"Knowing the gradient of the curvature function k of the plumblines of the Earth's normal gravity field at a point P (i.e. gradk at P) find the components of gradk at an arbitrary point Q in an small area around point P such that k(P) = k(Q) without using the curvature function twice and without using Taylor series of the curvature function".

In this application we will show that with the help of a spanner surface it is possible to introduce an alternative way of estimating gradk without the use of Taylor series. This is quite an advantage since it will not be necessary to involve high order partial derivatives of the normal potential (second order, third order) in our calculations. In addition we will show that only the first order partial derivatives of the normal potential are necessary for the estimation of gradk in a small area of the isocurvature surface.
In this problem we have two unknowns - which are the components of gradk expressed in a local Cartesian system – therefore we need two equations to relate these components with the components of gradU. The desired system of algebraic equations is formulated with the aid of a chosen spanner surface related to the original isocurvature surface. The spanner surface is chosen to be an equipotential surface of the normal gravity field. The solution of this algebraic system will show that the components of gradk at point Q are expressed as a combination of the components of gradU. This theoretical problem may be proven very hard or impossible to be solved without the use of a spanner surface.