Nearest Point-Geodesic Problem

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Abstract

The problem states: Given a Geodesic, defined by the shortest path between two points on a sphere's surface, and a random point on the sphere's surface, find the closest point on that line to that random point.

1 Introduction

We will Use the wgs84 coordinate system, and repersent the Earth as a oblate spheroid. The difficulty in this problem comes from the issue of the Earth's irregular shape.

2 Kyler's Solution

Take the Geodesic's endpoints (P_1, P_2), along with the random point, R_1, and construct a triangle, $\triangle P_1 P_2 R_1$, using Vincenty's formulae to construct the edges. Then, take the midpoint of $\overline{P_1 P_2}$, and construct a new line using this new midpoint, M_1 and R_1. Throw out whichever line is longer $\overline{R_1 P_1}$ or $\overline{R_1 P_2}$, and replace it with $\overline{R_1 M_1}$. Repeat this process until $\overline{P_1 P_2}$ is within the specified tolerance. This algorithm is $O(\log_2(n))$, where n is equal to the orignal length of $\overline{P_1 P_2}$. It takes $log_2(n)$ steps to reach the specified tolerance.