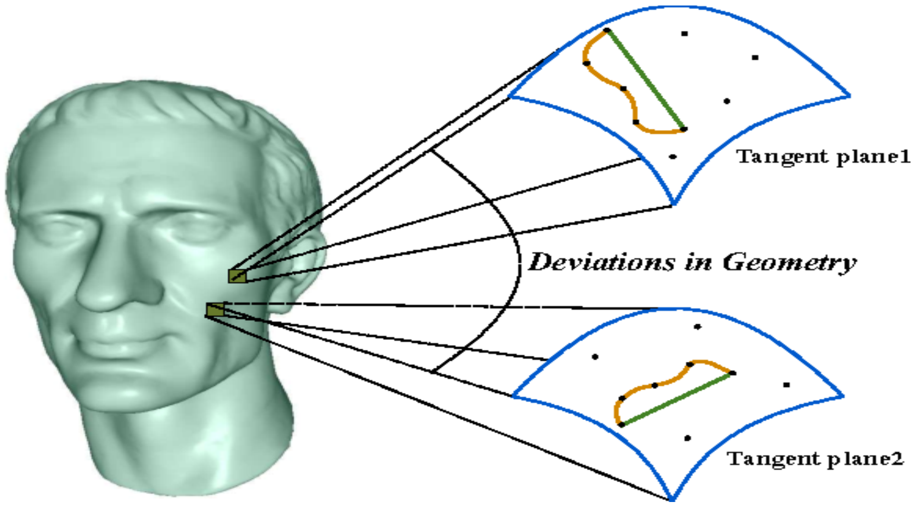
Appendix XI



In:

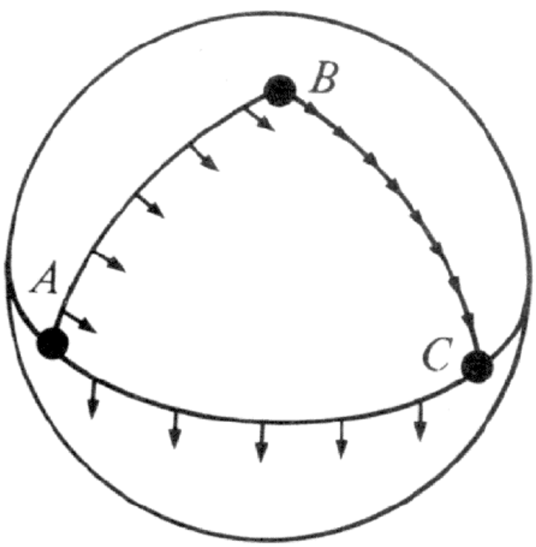
Metric tensor and Christoffel symbols based 3D object categorization

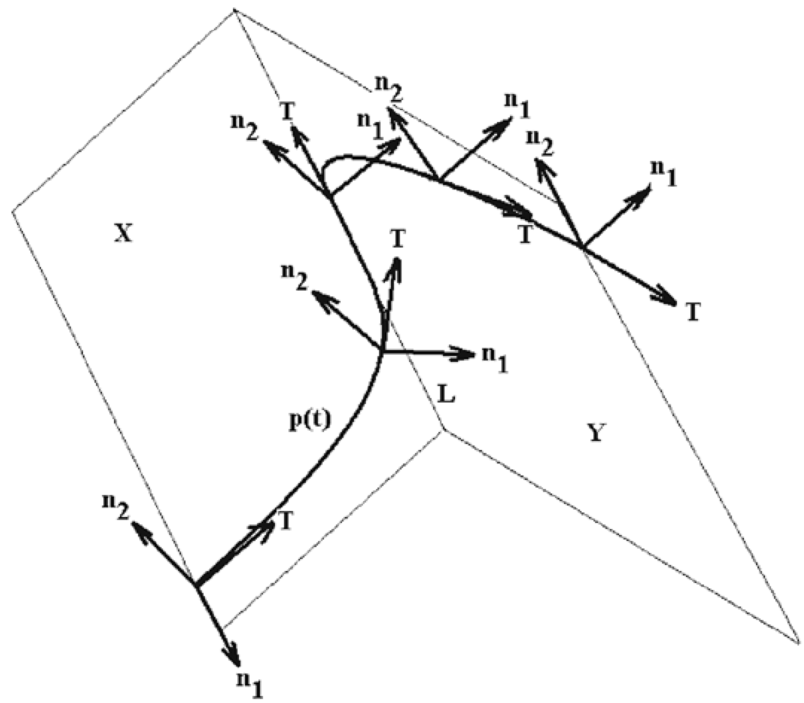
Syed Altaf Ganihar, Shreyas Joshi, Shankar Setty and Uma Mudenagudi

SIGGRAPH Posters, 2014

Fig. 4. The computation of Christoffel symbols for a 3D object is carried out on a pair of neighboring local tangent planes by computing the deviations in the metric tensor over the tangent planes.

Parallel transport:





The Parallel Transport Frame

Authors: Carl Dougan

In book:

Game Programming Gems 2
Edited by Mark DeLoura

Charles River Media, 2001
ISBN 1-58450-054-9

See on Amazon

Pages: 215–219

Citation: Carl Dougan. “The Parallel Transport Frame”. In *Game Programming Gems 2*, Charles River Media, 2001, pp. 215–219.

Appendix XI

Moving Path Following for Autonomous Robotic Vehicles

Tiago Oliveira[1] Pedro Encarnação[2] A. Pedro Aguiar[3]

***Abstract*— This paper introduces the moving path following (MPF) problem for autonomous robotic vehicles, in which the vehicle is required to converge to and follow a desired geometric moving path, without a specific temporal specification. This case generalizes the classical path following problem, where the given path is stationary. Possible tasks that can be formulated as a MPF problem include terrain/air vehicles target tracking and gas clouds monitoring, where the velocity of the target/cloud specifies the motion of the path. Using the concept of parallel-transport frame associated to the geometric path, we derive the MPF kinematic-error dynamics for 3D paths with arbitrary motion specified by its linear and angular velocity. An application is made to the problem of tracking a target on the ground using an Unmanned Aerial Vehicle. The control law is derived using Lyapunov methods. Formal convergence results are provided and hardware in the loop simulations demonstrate the effectiveness of the proposed method.**

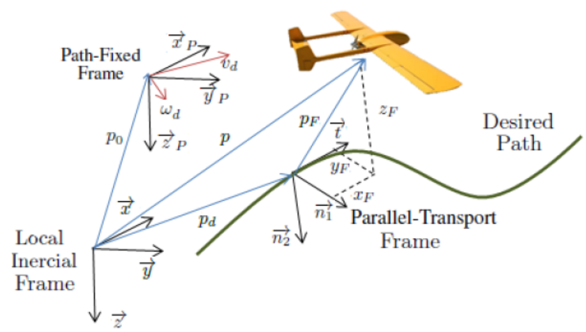
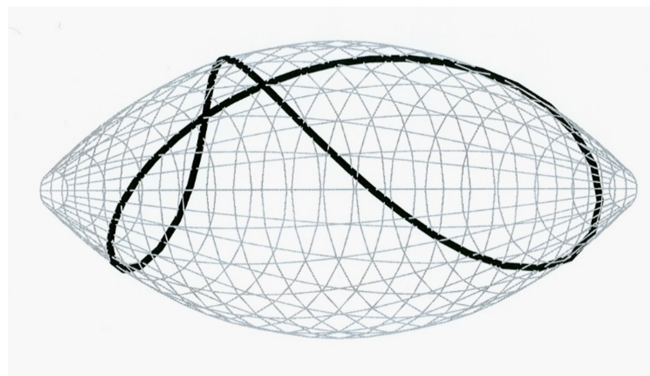
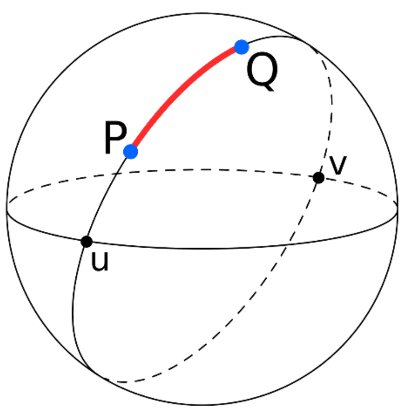


Fig. 1. Error space frames, illustrating for the case of an UAV.



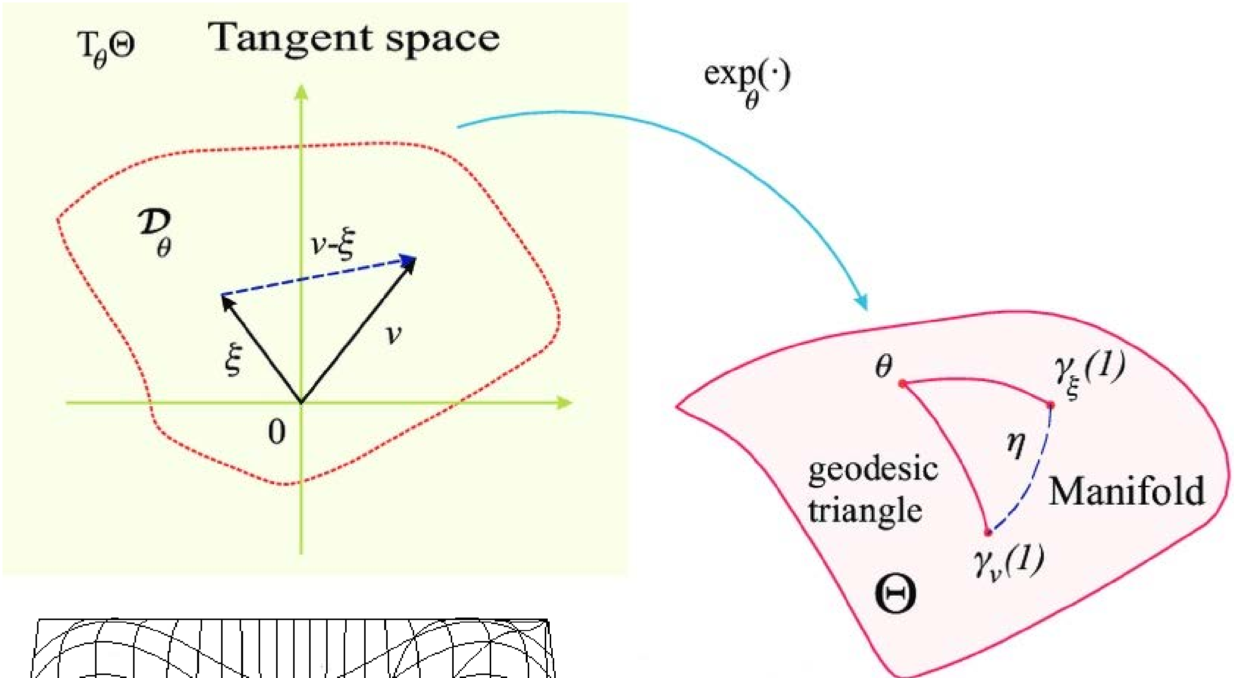
Geodesics:

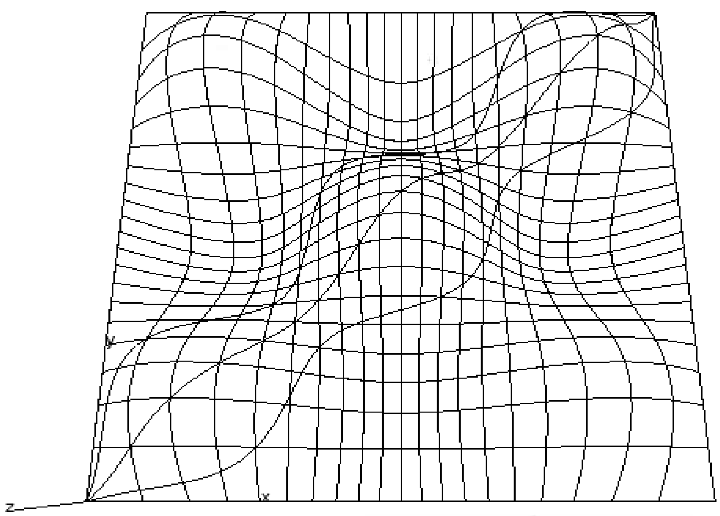


Geodesic equation:

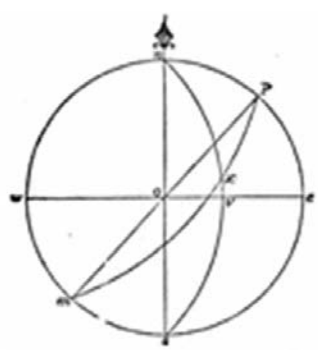
$$\frac{d^2x^\alpha}{d\tau^2}+\Gamma^\alpha_{\beta\gamma}\frac{dx^\beta}{d\tau}\frac{dx^\gamma}{d\tau}=0$$

The exponential map:

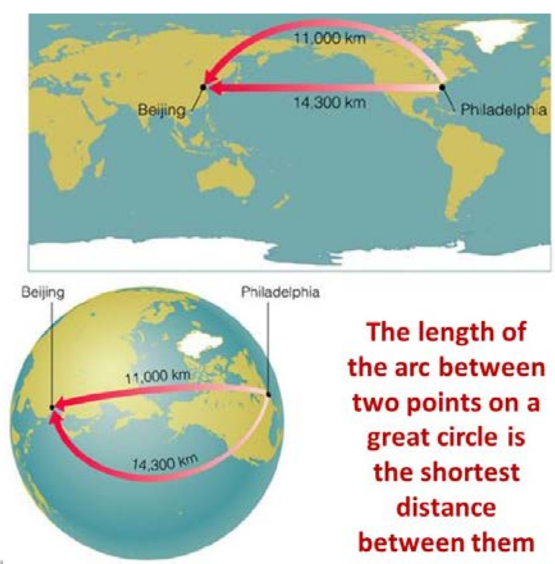




Geodesics: shortest paths



Great Circle is the circle on the surface of a sphere formed by intersecting with a plane passing through its Centre



The length of the arc between two points on a great circle is the shortest distance between them

http://www.astro.umass.edu/~myun/teaching/a100/longlecture17.html