L Garnier et al., J Comput Eng Inf Technol 2015, 5:4(Suppl)
http://dx.doi.org/10.4172/2324-9307.C1.009

The minkowski-lorentz space for computer aided design purposes

L Garnier[1], **J P B´ecar**[2], **L Druoton**[3], **R Langevin**[3], **L Fuchs**[4] and **G Morin**[5]
[1]Le2i - Laboratory Electronics, Informatics and Image, France
[2]LAMAV/CGAO University of Valenciennes, France
[3]Institute of Mathematics of Burgundy, France
[4]SIC Department of Laboratory XLIM, France
[5]Research Institute in Computer Science of Toulouse (IRIT) Laboratoire, France

This poster deals with the Minkowski-Lorentz space and applications in the Computer Aided Geometric design The Minkowski-Lorentz space generalises to $\mathbb{R}^5$ the one used in the relativity theory. A bilinear and its quadratic forms state the Minkowski-Lorentz space for $\mathbb{R}^5$. For CAD purposes, the working set in that space is a unit sphere denoted by λ^4.The Minkowski-Lorentz space embeds $\mathbb{R}^3$. The spheres and planes in $\mathbb{R}^3$ are considered as points on λ^4 in the Minkowski-Lorentz space. Moreover, some quadratic calculation in $\mathbb{R}^3$ becomes linear in $\mathbb{R}^5$. The pencils of spheres in $\mathbb{R}^3$ are modelled by the intersection of a plane with λ^4. The result is a unit circle given three situations. Depending on the space-like plane, light-like plane, time-like plane, the unit intersection circle looks like an ellipse, two straight lines or a hyperbola. The terms light cone, like-like, space-like, time-like vectors were found by Minkowski. The envelope of a one-parameter family of spheres in $\mathbb{R}^3$ defines a canal surface which is a curve on λ^4. That makes the use of algorithms based on canal surfaces easier than in $\mathbb{R}^3$. The Dupin cyclides are well known and particular cases of canal surfaces. On λ^4, a Dupin cyclide is represented by two circles which look like ellipse(s) or hyperbola or by a circle, which look like an ellipse, and a parabola isometric to a line. They provide new algorithm in CAD purposes. An example of G^1 joined Dupin cycles is shown in a schematic seahorse.

Biography

L Garnier obtained a PhD thesis on computer science from the University of Burgundy, France in 2004 on the use of Dupin cyclides and supercyclides in geometric modelling. His research interests include shape modelling using algebraic and parametric surfaces, surfaces blending, and geometric constraints based modelling. To simplify the blends of canal surfaces using Dupin cyclides, the space of spheres in the Minkowski-Lorentz space is used. In this space, any canal surface is represented by a curve and a Dupin cyclide is modelled by two conics. Using these spaces, the blend of these surfaces is very easy: it is enough to join two curves. Moreover, the conics can be represented by Bézier curves and mass points.

lionel.garnier@u-bourgogne.fr

Notes: