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Curvatures of the Translation Hypersurface in 4-Space

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Abstract

We study curvatures $\mathfrak{C}_{i=1,2,3}$ of translation hypersurface in the four dimensional Euclidean space. We also give some relations on $\mathfrak{C}_i$ of translation hypersurface.

1. Introduction

We see some nice papers about translation surfaces (TS) and translation hypersurfaces (TH) in the literature such as [1-17].

Arslan et al [1] worked TS in 4-dimensional Euclidean space; Chen, Sun, and Tang [2] studied TH with constant mean curvature (CMC) in $(n+1)$-dimensional spaces; Dillen, Verstraelen, and Zafindratafa [3] focused a generalization of the TS of Scherk; Inoguchi, Lopez, and Munteanu [4] gave minimal TS in the Heisenberg group Nil_3; Lima, Santos, and Sousa [5] introduced TH with constant scalar curvature into the Euclidean space; Lima, Santos, and Sousa [6] studied generalized TH in Euclidean space; Liu [7] considered TS with CMC in 3-dimensional spaces; Lopez [8] worked minimal TS in hyperbolic space; Lopez and Moruz [9] studied translation and homothetical surfaces with constant curvature in Euclidean space; Lopez and Munteanu [10] worked minimal TS in Sol_3; Moruz and Munteanu [11] obtained hypersurfaces in the Euclidean space $\mathbb{E}^4$ defined as the sum of a curve and a surface whose mean curvature vanishes; Munteanu, Palmas, and Ruiz-Hernandez [12] worked minimal TH in Euclidean space; Scherk [13] found his classical minimal TS; Seo studied [14] TH with constant curvature in space forms; Verstraelen, Walrave, and Yaprak [15] studied on the minimal TS in $\mathbb{E}^n$; Yang and Fu [16] considered affine TS in affine space; Yoon [17] focused the Gauss map of TS in Minkowski 3-space.

A translation surface in $\mathbb{E}^3$ is a surface generated by translations. For two space curves α, β with a common point P, the curve α is shifted such that point P is moving on β. Then the curve α generates a TS

$$\mathbf{x}(u,v) = \alpha(u) + \beta(v).$$

A translation hypersurface in the four dimensional Euclidean space $\mathbb{E}^4$ is a hypersurface generated by translations: for three space curves α, β, γ with a common point P, the curve α is shifted such that point P is moving on β and γ, respectively. Then, the curve α generates a TH in $\mathbb{E}^4$. TH is parametrized by

$$\mathbf{x}(u,v,w) = \big(u, v, w, f(u) + g(v) + h(w)\big). \tag{1.1}$$

where $f(u), g(v), h(w)$ are differentiable functions for all $u, v, w \in I \subset \mathbb{R}$. More clear form of it as follows

In this work, we obtain curvatures of hypersurfaces in $\mathbb{E}^4$. We present basic elements of the four dimensional Euclidean geometry. Moreover, we compute curvatures $\mathfrak{C}_{i=1,2,3}$ of TH.