



A Tale of Two Arc Lengths: Metric notions for curves in surfaces in equiaffine space

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(Submitted on 1 May 2012)

In Euclidean geometry, all metric notions (arc length for curves, the first fundamental form for surfaces, etc.) are derived from the Euclidean inner product on tangent vectors, and this inner product is preserved by the full symmetry group of Euclidean space (translations, rotations, and reflections). In equiaffine geometry, there is no invariant notion of inner product on tangent vectors that is preserved by the full equiaffine symmetry group. Nevertheless, it is possible to define an invariant notion of arc length for nondegenerate curves, and an invariant first fundamental form for nondegenerate surfaces in equiaffine space. This leads to two possible notions of arc length for a curve contained in a surface, and these two arc length functions do not necessarily agree. In this paper we will derive necessary and sufficient conditions under which the two arc length functions do agree, and illustrate with examples.

Comments: 14 pages, 7 figures

Subjects: **Differential Geometry (math.DG)**

MSC classes: 53

Cite as: [arXiv:1205.0065](#) [math.DG]

(or [arXiv:1205.0065v1](#) [math.DG] for this version)

Submission history

From: Jeanne N. Clelland [[view email](#)]

[v1] Tue, 1 May 2012 01:15:32 GMT (877kb,D)

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