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On the Tangential Velocity Arising in a Crystalline Approximation of Evolving Plane Curves

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Abstract: In a crystalline algorithm, a tangential velocity is used implicitly. In this short note, it is specified for the case of evolving plane curves, and is characterized by using the intrinsic heat equation.

Keywords: tangential velocity; intrinsic heat equation; crystalline algorithm; admissible polygonal curve;

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References

[1] S. Angenent and M. E. Gurtin: Multiphase thermomechanics with interfacial structure, 2. Evolution of an isothermal interface. Arch. Rational Mech. Anal. 108 (1989), 323–391.

[2] K. Deckelnick: Weak solutions of the curve shortening flow. Calc. Var. Partial Differential Equations 5 (1997), 489–510.

[3] G .Dziuk: Convergence of a semi discrete scheme for the curve shortening flow. Math. Models Methods Appl. Sci. 4 (1994), 589–606.

[4] Y. Giga: Anisotropic curvature effects in interface dynamics. Sūgaku 52 (2000), 113–127; English transl., Sugaku Expositions 16 (2003), 135–152.

[5] M.-H. Giga and Y. Giga: Crystalline and level set flow – convergence of a crystalline algorithm for a general anisotropic curvature flow in the plane. GAKUTO Internat. Ser. Math. Sci. Appl. 13 (2000), 64–79.

[6] M. E. Gurtin: Thermomechanics of Evolving Phase Boundaries in the Plane. Clarendon Press, Oxford 1993.

[7] C. Hirota, T. Ishiwata, and S. Yazaki: Numerical study and examples on singularities of solutions to anisotropic crystalline curvature flows of nonconvex polygonal curves. In: Advanced Studies in Pure Mathematics (ASPM); Proc. MSJ-IRI 2005 "Asymptotic Analysis and Singularity", Sendai 2005 (to appear).

[8] H. Hontani, M.-H. Giga, Y. Giga, and K. Deguchi: Expanding selfsimilar solutions of a crystalline flow with applications to contour figure analysis. Discrete Appl. Math. 147 (2005), 265–285.

[9] T. Ishiwata, T. K. Ushijima, H. Yagisita, and S. Yazaki: Two examples of nonconvex self-similar solution curves for a crystalline curvature flow. Proc. Japan Academy, Ser. A 80 (2004), 8, 151–154.

[10] M. Kimura: Accurate numerical scheme for the flow by curvature. Appl. Math. Letters 7 (1994), 69–73.

[11] K. Mikula and D. Ševčovič: Solution of nonlinearly curvature driven evolution of plane curves. Appl. Numer. Math. 31 (1999), 191–207.

[12] K. Mikula and D. Ševčovič: Evolution of plane curves driven by a nonlinear function of curvature and anisotropy. SIAM J. Appl. Math. 61 (2001), 1473–1501.

[13] J. E. Taylor: Constructions and conjectures in crystalline nondifferential geometry. In: Proc. Conference on Differential Geometry, Rio de Janeiro, Pitman Monographs Surveys Pure Appl. Math. 52 (1991), pp. 321–336, Pitman, London 1991.

[14] J. E. Taylor: Motion of curves by crystalline curvature, including triple junctions and boundary points. Diff. Geom.: Partial Diff. Eqs. on Manifolds (Los Angeles 1990), Proc. Sympos. Pure Math., 54 (1993), Part I, pp, 417–438, AMS, Providence.

[15] J. E. Taylor, J. Cahn, and C. Handwerker: Geometric models of crystal growth. Acta Metall. 40 (1992), 1443–1474.

[16] T. K. Ushijima and H. Yagisita: Approximation of the Gauss curvature flow by a three-dimensional crystalline motion. In: Proc. Czech–Japanese Seminar in Applied Mathematics 2005; Kuju Training Center, Oita, Japan, September 15–18, 2005, COE Lecture Note 3, Faculty of Mathematics, Kyushu University (M. Beneš, M. Kimura, and T. Nakaki, eds.), 2006, pp. 139–145.

[17] T. K. Ushijima and H. Yagisita: Convergence of a three-dimensional crystalline motion to Gauss curvature flow. Japan J. Indust. Appl. Math. 22 (2005), 443–459.

[18] T. K. Ushijima and S. Yazaki: Convergence of a crystalline approximation for an area-preserving motion. Journal of Comput. and Appl. Math. 166 (2004), 427–452.

[19] S. Yazaki: Motion of nonadmissible convex polygons by crystalline curvature. Publ. Res. Inst. Math. Sci. 43 (2007), 155–170.