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SINGULARITY THEORY AS A TOOL IN APPLIED MATHEMATICS

A singularity of a smooth map is a point where the Jacobian matrix fails to have maximal rank, so first order information is not enough to determine local geometry. The lectures will introduce basic ideas of equivalence under local coordinate changes, and the key concepts of determinacy (getting rid of higher order terms) and unfolding (capturing local behaviour when the singularity is deformed). The methods will be illustrated by examples in low dimensions and by the Thom/Arnold classification of elementary catastrophes. Applications may include (as time permits) geometry of outlines and projections, caustics and gravitational lensing, local dynamics of impact oscillators and aspects of bifurcation theory for ODEs and PDEs.

References

- [1] Martinet, Jean. *Singularities of Smooth Functions and Maps*, LMS Lecture Notes Vol. 58, CUP Archive 1982.
- [2] Arnold, V. I., Gusein-Zade, S. M., and Varchenko, A. N., *Singularities of Differentiable Maps*, Birkhäuser 1985 (reprinted Springer 2012).
- [3] Petters, A. O., Levine, H. and Wambsganss, J., *Singularity Theory and Gravitational Lensing*, Birkhäuser 2001. [In particular Part III].