

Optimization and Homotopy in Mathematical Handwriting Recognition

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Mathematical handwriting, with its nested subscripts and superscripts, conveys information by the vertical placement of symbols. Unlike other areas of handwriting analysis, where a baseline can be used to disambiguate symbols, the opposite is true in mathematics: local vertical maxima, minima and inflections of symbols curves determine various metric lines, including the baseline. We show how handwritten symbols can be modelled as parametric plane curves approximated by certain truncated orthogonal series. Symbols are then represented as points in a space of coefficients with dimension chosen to make symbol classes linearly separable. This allows linear homotopies between symbols of the same class, and in particular newly written symbols can be deformed smoothly to representative symbols with known points determining the metric lines. This can be used to find the neighbourhood of the corresponding determining points of the newly written symbol, after which numerical optimization finds the actual points.