

The Registration Problem in Functional Data Analysis

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Abstract

Functional data analysis deals with data representing a number of different, but related curves. Many important studies in various fields of application generate this type of data.

Most established methods in this domain are based on generalizations of procedures developed for the multivariate analysis of random vectors.

However, curve data can pose additional problems which have no counterpart in multivariate analysis.

For example, when analyzing human growth curves it turns out that growth velocity of different children possesses a common pattern: growth velocity decreases rapidly after birth up to a certain point around age 5 or 6; then there is a slight increase in growth velocity, the so-called mid-growth spurt, followed by a decreasing trend up to the onset of puberty which gives rise to a pubertal growth spurt.

Different children pass through this structural pattern with individually different intensities and differing dynamics. In particular, puberty occurs at different ages, and the pubertal growth spurt is realized with varying height and location.

This property of growth curves constitutes a specific case of the so-called registration problem. The point is that an application of functional generalizations of multivariate methods does not make much sense if curves differ in intensity and in dynamics. Even the point wise average curve will usually not represent a typical structure appropriately, since corresponding structural features (like the pubertal growth spurt) are realized at different locations, and averaging takes place over non-comparable curve segments.

The talk will highlight the importance of the registration problem in functional data analysis. Possible solutions proposed by different authors will be discussed.