Approximation of manifold-valued data

One of the characteristic features of our modern age is the deluge of data we are confronted with. In addition to the mere masses, we are witnessing more and more modern sensing devices where measurements are of a nonstandard form with data points constrained to certain nonlinear geometries. With applications ranging from topics in human biomechanics, over image processing, kinematics and robotics, numerical linear algebra, model reduction to computer graphics, nonlinear data represents a fact of life in modern computational science and therefore it is of eminent interest to develop useful computational and theoretical tools capable of processing manifold-valued functions. These lectures are intended to present an overview of the present state-of-the-art for the processing of nonlinear data. After presenting some motivation and examples in the first lecture, I will show how known concepts like wavelets or finite element methods for the numerical solution of PDEs can be generalized to a manifold-valued setting. Applications in data compression, image denoising and geometric PDEs will be discussed.