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Marcinkiewicz–Zygmund type sampling discretization theorems

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In the talk we are going to discuss the recent progress concerning Marcinkiewicz–Zygmund type sampling discretization. Informally speaking, sampling discretization studies how one can replace the integral L^p norms for a class of functions by the evaluation of these functions at a fixed small set of points. On the one hand, such problems are classical. The first results in sampling discretization were obtained in 1937 by Marcinkiewicz for L^p -norms with $p \in (1, +\infty)$ and by Marcinkiewicz and Zygmund for L^1 -norm for the class of univariate trigonometric polynomials. On the other hand, the systematic study of sampling discretization has begun only recently.

In more detail, let $C(\Omega)$ be the space of all continuous functions on some compact subset Ω of \mathbb{R}^n equipped with a probability Borel measure μ . Let L be some N -dimensional subspace of $C(\Omega)$, let $p \in [1, +\infty)$, and $\varepsilon \in (0, 1)$. We aim to determine the least possible integer m such that there are points $x_1, \dots, x_m \in \Omega$, for which

$$(1 - \varepsilon)\|f\|_p^p \leq \frac{1}{m} \sum_{j=1}^m |f(x_j)|^p \leq (1 + \varepsilon)\|f\|_p^p \quad \forall f \in L$$

where $\|f\|_p^p := \int_{\Omega} |f(x)|^p \mu(dx)$ and $\|f\|_{\infty} := \max\{|f(x)| : x \in \Omega\}$. Clearly, m cannot be less than the dimension N of the subspace L . Thus, we are interested in the conditions under which the number of point m is close to the dimension N .