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Ramon van Handel: Vector concentration inequalities

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The concentration of measure phenomenon asserts that in a remarkably broad range of situations, nonlinear functions of many random variables are well concentrated around their means. A question that arises naturally in probability theory, functional analysis, metric geometry, and geometric group theory is whether there exist analogous phenomena for vector-valued functions, i.e., taking values in normed spaces. While this question is seemingly innocuous on its face, it is not even clear in first instance how it can be meaningfully formulated or approached.

What is arguably the "correct" way to think about this problem was discovered by Pisier in the 1980's in the setting of Gaussian measures. The extension of Pisier's ideas beyond the Gaussian setting was a long-standing problem. A few years ago, our work with Ivanisvili and Volberg provided one further example: a vector concentration inequality on the discrete cube. (There are also related works of Lafforgue and Mendel-Naor for very carefully designed models of expander graphs.) All these situations are rather special, and fall far short of the richness and broad applicability of the classical concentration of measure theory. In this talk I aim to describe the current status of a long-term effort to discover more general principles behind the vector concentration phenomenon. Along the way we encounter some new probabilistic questions, unexpected phenomena, and (unfortunately) plenty of unexplained mysteries.

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