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# Performance Guarantees for Random Fourier Features – Limitations and Merits\*

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## Abstract

Random Fourier features (RFF) are among the most popular and widely applied constructions for speeding up kernel methods: they (i) provide an easily computable, low-dimensional feature representation for shift-invariant kernels, (ii) enable to approximate kernel machines in the primal form through fast linear algorithms, (iii) suit well to online applications. Despite the popularity of RFFs, very little is understood theoretically about their approximation quality. In this talk, I am going to present the first detailed finite-sample theoretical analysis about the approximation quality of RFFs by (i) establishing optimal (in terms of the RFF dimension, and growing set size) performance guarantees in uniform norm, (ii) providing guarantees in more general  $L^r$  ( $1 \leq r < \infty$ ) norms, and (iii) we also extend the analysis to the approximation of kernel derivatives. These results give insight into the limitations and merits of RFFs.

Preprint: <http://arxiv.org/abs/1506.02155>

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\*University of Sheffield, UK; June 24, 2015; abstract.

<sup>†</sup>Joint work with Bharath K. Sriperumbudur (Department of Statistics, Pennsylvania State University).