Regularized kernel greedy algorithms

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Kernel methods provide powerful and flexible techniques to approximate functions defined on general domains, with possible high-dimensional input and output spaces, and using samples at scattered locations. Thanks to this high flexibility, they have been increasingly used in the recent times to produce surrogates, i.e., cheap approximate models which are used to replace highly accurate but expensive simulations.

In this context, greedy methods have proven to be particularly effective. Indeed, they allow to construct good approximants based on small, thus cheap to evaluate expansions. The approximant is constructed using a small set of kernel centers, which are selected in an efficient way by picking at each iteration the point which maximizes a certain selection criterion.

We will present an extension of the f- and P-greedy version of the VKOGA algorithm [3] to the case of regularized interpolation problems [2]. This setting is interesting because it allows to tune a trade-off between stability and pointwise accuracy, it can be used with non strictly positive definite kernels such as polynomial kernels, and it can deal with noisy data.

In the case of the P-greedy selection, we also extend the proof of quasi-optimal convergence rates of [1], and show that they still hold in this case.

Experimentally, we test the method on reference problems using polynomial kernels, and we demonstrate the potential of the kernel-based surrogates in the simulation of the blood-flow in a vascular network [4].

References

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