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# QKLT: KARHUNEN-LOEVE TRANSFORM ON QUANTUM COMPUTING

**Abstract**

Computer technology has been driven to smaller and smaller scales because, ultimately, the limiting factor on the speed of microprocessors is the speed with which information can be moved around inside the device.

In 1965 Gordon Moore, a co-founder of Intel, noticed that the most economically favourable transistor densities in integrated circuits seemed to have been doubling roughly every 18 months.

Today, many industry insiders see Moore's Law surviving for just two or three more generations of microprocessors at best. In a valiant effort to sustain Moore's Law, chip manufacturers are migrating to multi-core microprocessor architectures, and exotic new semiconductor materials, but a switch to nanotechnology it seems now necessary, so much to consider as realistic the one-atom-per-bit level computing paradigm.

Kurzweil law" states that to guarantee the exponential growth of technological progress when some kind of barrier is approached, a new technological paradigm has to be invented, as it was for planar technology substituting the early transistor era. Quantum technologies represent this paradigm shift, which aims to put at work the mysterious issues of the quantum world to build conceptually new machines.

Quantum Computing is the computer science that studies the application of this new computer paradigm whose immediate effect is to drastically increase the power of computing, by decreasing the computational complexity of highly complex problems, thanks also to the intrinsically parallel nature of quantum algorithms and methods.

This last performance improvement is well applied successfully to algorithm that often require parallelism in processing input data , as for example FFT, and should be extended to other signal processing and techniques as PBF (Polyphase Bank Filter), and in particular Karhunen Loeve Transform (KLT), that is the focus of this work. This mathematical algorithm is superior to the classical FFT for a number of signal processing application, and in particular for de-noising and filtering out of the background noise, both wide and narrow bands coherent signals, coming from non-stationary process in time; while FFT algorithm rigorously applies to narrow-band and stationary signals only. Thanks to its non-stationary and wide band nature, KLT can detect coherent signals buried in noise to unbelievably small values of the Signal-to-Noise Ratio (SNR).

The purpose of this work is to study a method to implement KLT algorithms in a simulated quantum computing environment, laying the foundation for a fast KLT computation method that enhances the quantum nature for KLT itself.