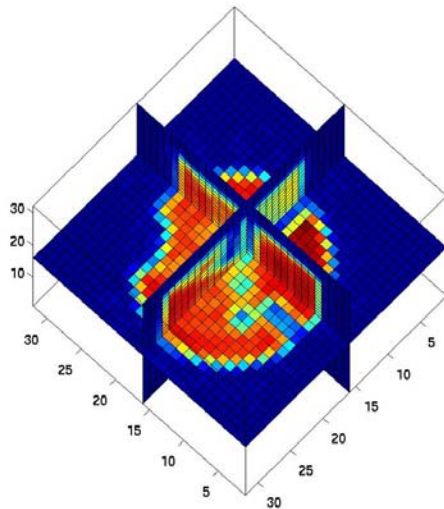
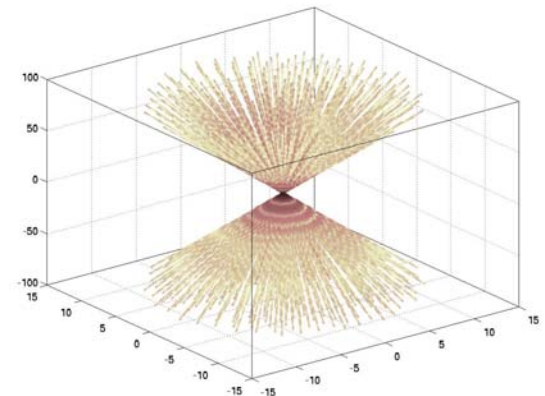


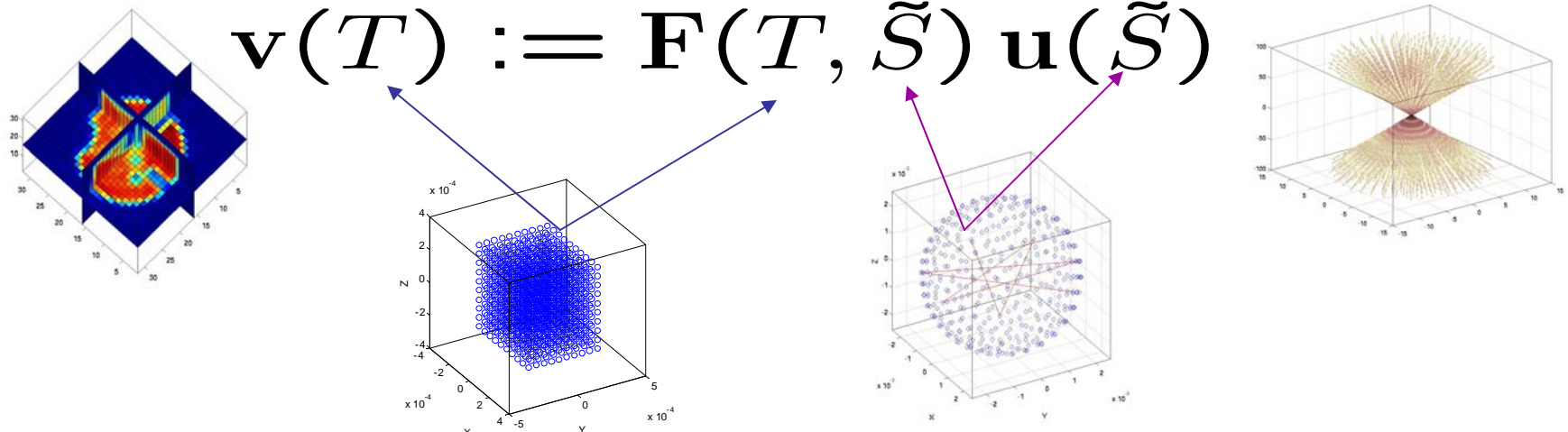
Parallelization of NUFFT with Radial Data on Multicore Processors



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NUDFTs & NUFFT_s



$$c(T) \odot v(T) \approx F(T, S) C(S, \tilde{S}) u(\tilde{S})$$

Data samples : on-equally spaced on Cartesian Grid, or with non-uniform density explicitly specified

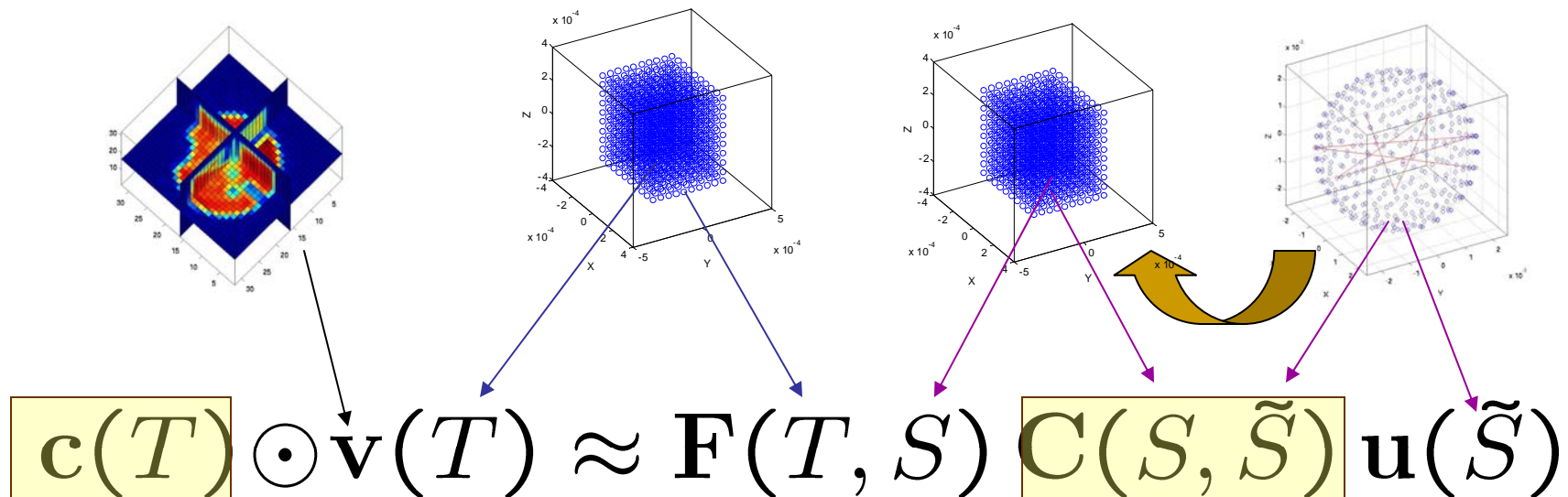
NUDFT

- not exceptional ; FFTs often follow **sample translation**, interpolation re-gridding
- not restricting on sampling distribution or conflicting with acquisition conditions
- not combinatorial as DFT

NUFFT

- $O(N \log(N) \log(1/\epsilon))$ in ϵ -approximation and in terms of arithmetic complexity
- Replace heuristic sample translations with unified theory and methods (1995)
- Great potential to enable many high-precision image/data processing applications
- However, many obstacles in reaching the potential

Sample Translation



Sample Translation by the Convolution Theorem

- While an equally-spaced convolution may be accelerated by FFTs, well-chosen locally-supported convolution transforms can accelerate NUDFTs.
- Two basic approaches for choosing a translation-scaling pair : analytical, numerical
- Sample translation is specific to sample distribution and acquisition ordering
- Sample translation is subject to the constraints in FFT implementation

NUFFT Acceleration History with Radial Data

NUFFT Version	4-core PPC G5 @ 2.5 GHz 12GB RAM	8-core Opteron @ 3.0 GHz 8GB RAM	Program & Algorithm Transformations
0	27 hrs		original version
1	4 hrs	12 hrs	sub-expression extraction
2		3 hrs 45 mins	scratch memory reuse
3	1 hr 10 mins	2 hrs 50 mins	dynamic coordinates decoding
4		1 hr 50 mins	streaming of data reads
5		15 mins	geometric binning, multithreading & scaling fusion

