Algebra and Geometry Combined Explains How the Human Mind Does Applied Math

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Abstract. The original title of this talk was "In-Place Transposition Helps Explain Effective Cache Blocking". I decided to change the title as it explains how human beings do math in the brain. Over the past eight years almost all computer manufacturers have dramatically changed their computer architectures to become Multicore (MC) processors. We again briefly describe Cache Blocking as it relates to computer architectures since about 1985 by covering the where, when, how and why of Cache Blocking as it relates to dense linear algebra. We also briefly present new algorithms for In-Place Rectangular Transposition of an M by N matrix A. This new works complement older work at PPAM 11 on the GKK algorithm that appeared in TOMS during 2012. The new work is based on a 2004 patent which I called GCD transpose and on the 2011 paper of Tretyakov & Tyrtyshniov. David Walker and I will also discuss the TT algorithm at PPAM 13. We again emphasize the importance of Rectangular Block (RB) format and also describe how and why efficient algorithms are possible between RB format and standard column and row major formats of 2-D arrays in the Fortran and C languages. Also at PPAM 13 work on the LAPACK positive definite symmetric band matrix algorithm called DPBTRF will be discussed in the talk "Square Block Code for Positive Definite Symmetric Cholesky Band Routines" by Joseph Herrero, Enric Morancho and myself. This work benefits from in-place transformations of submatrices of a symmetric band matrix.
From a practical point of view, this work continues to be very important as it will allow existing codes using LAPACK and ScaLAPACK to remain usable by new versions of LAPACK and ScaLAPACK which are currently being developed.