

The background is a collage of various digital and technological images. It includes a world map, a hand typing on a keyboard, a circuit board, and various data visualizations like bar charts and text strings. The overall color scheme is dominated by blue and green tones.

nag

Numerical Algorithms Group

Mathematics and technology for optimized performance

Numerical Excellence in Finance

Dr Ian Reid

Results Matter. Trust NAG.

Agenda

- Introduction to NAG
- Use of NAG software & services in finance
- NAG and NVIDIA

NAG

- Founded 1970
 - Co-operative software project
 - not-for-profit organisation
- £7m+ financial turnover
- 80+ employees
 - >>50% developers/technical consultants
- Main Offices
 - Oxford (HQ), Manchester, UK
 - Chicago, USA
 - Tokyo, Japan
- Over 3,000 customer sites world-wide

Results Matter. Trust NAG.

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Key NAG Products & Services

- Numerical and Statistical Libraries
 - Over 1600 user-callable components
- Consultancy Services
 - Code development, tuning, tailoring
- HPC Services
 - Procurement advice, market watch, benchmarking
 - Computational Science and Engineering (CSE) support
- Experts in Numerical Engineering

Use of NAG Software in Finance

- Portfolio analysis / Index tracking / Risk management
 - Optimisation, linear algebra, copulas...
- Derivative pricing
 - PDEs, RNGs, multivariate normal, ...
- Fixed Income/ Asset management / Portfolio Immunization
 - Operations research
- Data analysis
 - Time series, GARCH, principal component analysis, data smoothing, ...
- Monte Carlo simulation
 - RNGs

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Results Matter. Trust NAG.

New for Mark 22


- New global optimization chapter
- ANOVA – Analysis of Variance
- Nearest Correlation Matrix
- Partial Least Squares Regression Analysis
- Prediction intervals for fitted models
 - Allow for uncertainty in forecasts
- Fast quantile selection routine
- Wavelets
- Adoption of LAPACK 3.1
- New Random Number Generators
 - Including Mersenne Twister
 - Sobol Sequence generator (50,000 dimensions)

NAG Software – work in progress...

- Bayesian Statistics
- Copulas
- Extreme Value Theory Statistics
- Generalised Mixed Effect Regression
- Monte Carlo engine
- Optimisation (particle swarm, ...)
- Special Functions
- Time series
- ..
- and much more

Why Use NAG Libraries?

- Global reputation for quality – accuracy, reliability and robustness...
- Extensively tested, supported and maintained code
- Reduce development time
- Concentrate on your key areas
- Components
 - Fit into your environment
 - Simple interfaces to your favourite packages
- Regular performance improvements!



*“My team uses NAG mathematical routines
wherever possible - NAG are the experts here
- we stick to what we are good at!”*

Alan Scowcroft,

*Retired - Managing Director, Equities Quantitative Research
UBS*

What happened to my treadmill?

- The treadmill has stopped...
- Multi-core/Many-core are a major challenge for existing codes
- GPGPUs offer an interesting solution for some key applications

NAG and NVIDIA

- NAG encourages strong software stack
 - CUDA/OpenCL, Core math library
- And appropriate hardware
 - Double precision (not always needed, but...), ECC
- Working with Mike Giles on a joint project to deliver monte-carlo components
 - RNGs, distributions, copulas
- Working with existing clients to explore potential products
 - NOT a full NAG Library port

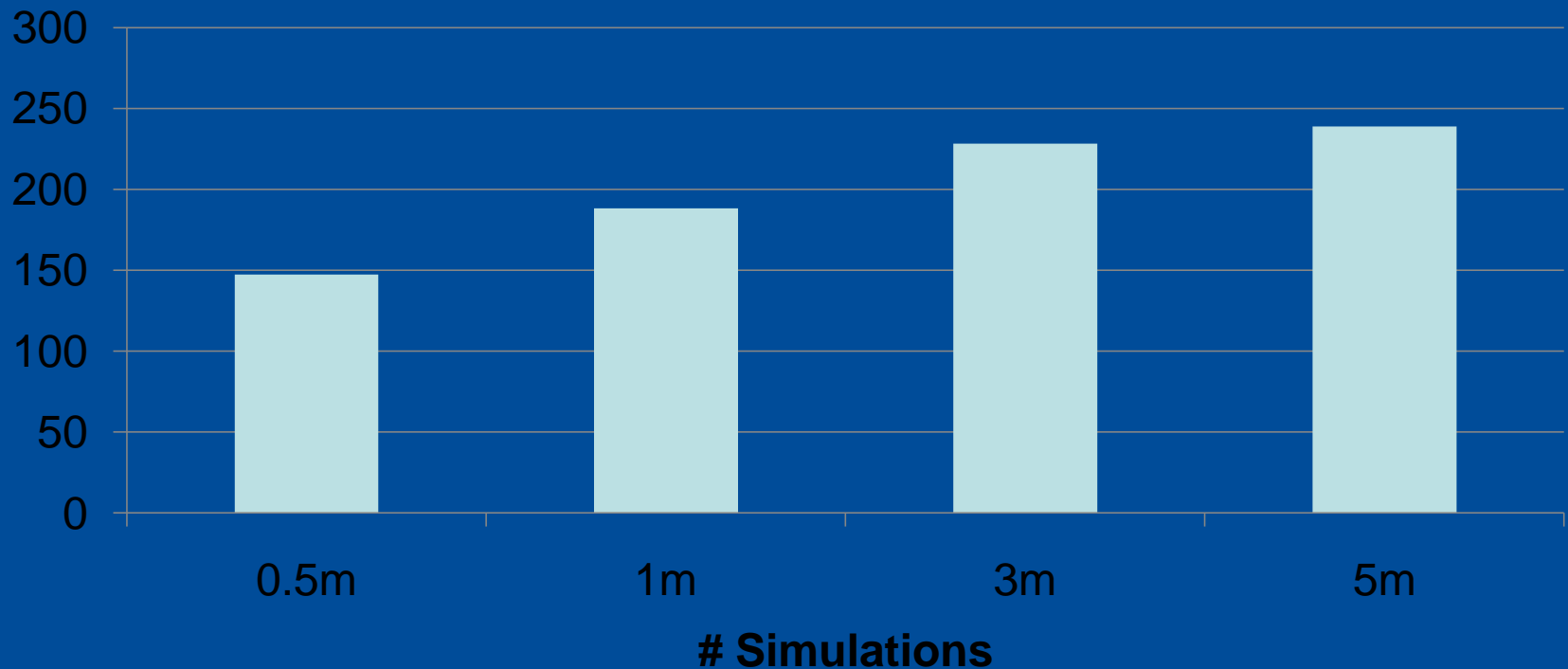
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Early Success with BNP Paribas

- Working with Fixed Income Research & Strategies Team (FIRST)
 - NAG mrg32k3a works well in BNP Paribas CUDA “Local Vol Monte-Carlo”
 - Passes “Diehard tests of randomness”
 - Performance good (next slide)
 - Being able to match the GPU random numbers with the CPU version of mrg32k3a has been very valuable for debugging purposes

BNP Paribas Results (work in progress)

Speed-up NAG MRG32k3a/GX260 versus BNP
CPU version



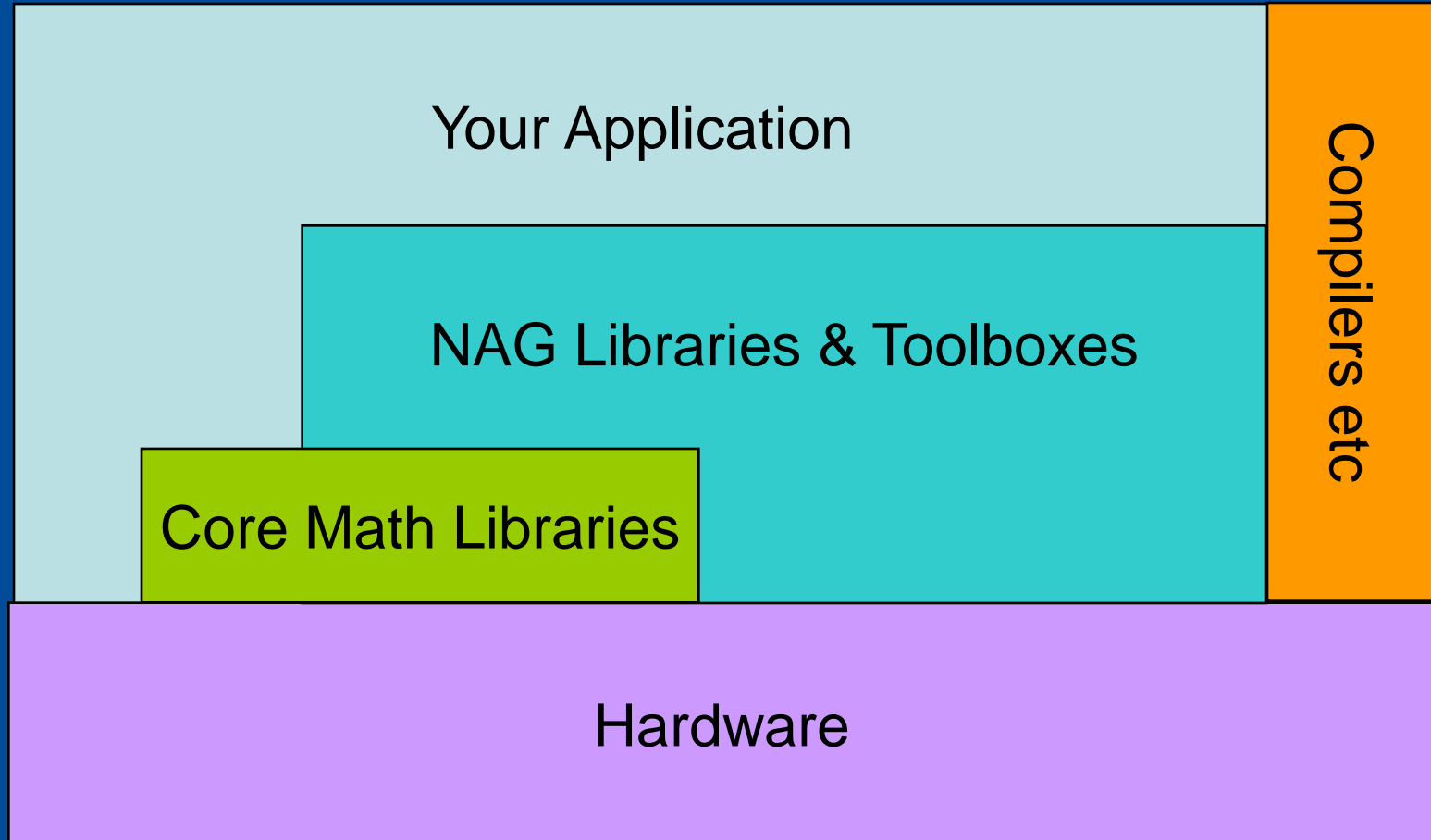
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Summary

- Difficult/exciting times for all
- Exciting developments on NVIDIA GPGPUs
- NAG is actively involved in R&D in this area and has beta software available
- NAG is seeking feedback on further areas of interest from your community

Backup Slides

NAG and Vendor libraries



NAG Library Contents

- NAG provides high-level maths and stats components
 - Nonlinear equation solvers
 - Summation of series and transformations, FFTs
 - Quadrature
 - ODEs, PDEs and integral equations
 - Approximation and curve and surface fitting
 - Optimization and operations research
 - Dense linear algebra, including LAPACK
 - Sparse linear systems and eigenproblems
 - Special functions
 - Random Number Generators
 - ...

NAG Libraries Ease of Integration

- C++ (various)
 - C# / .NET
 - Visual Basic
 - Java
 - Borland Delphi
 - Python
 - F#
 - ...
 - and more
- Excel
 - MATLAB
 - Maple
 - LabVIEW
 - R and S-Plus
 - SAS
 - ...
 - and more

Partnerships with leading academics

- University of Aachen
 - Prof. Uwe Naumann
 - Automatic Differentiation (AD)
- K.U. Leuven
 - Prof. Wim Schoutens
 - Option Pricing, Advanced Lévy models
- University of Manchester
 - Profs. Nick Higham (FRS), Peter Duck and Ser-Huang Poon
 - EVT's, Nearest Correlation Matrix, PDEs, Risk,
- University of Oxford
 - Profs. Mike Giles, Stephen Roberts
 - Monte Carlo simulation engine/ latest techniques/ high-end SIMD arch's
- University of Warwick
 - Prof. Nick Webber, Prof. Mark Salmon
 - Monte Carlo, Derivative Pricing, Copulas, Wavelets