INRIA CR2 Oral Audition

Malcolm Roberts

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Nancy, 2014-05-14

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Outline

- Academic History
- Research Summary
- Teaching, Outreach, and Service
- Publications and Software

Academic History

Postdoctoral Researcher, 2012-2014

- Laboratoire M2P2, Aix-Marseille University.
- SiCoMHD Project, ANR-funded.
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Summary of Research

- Implicitly Dealiased Convolutions and `fftw++`
- MHD Simulations in Complex Geometries
- The Multispectral Method
- Proposed Research

Implicitly Dealiased Convolutions

Convolutions are important operations:

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- Integer multiplication
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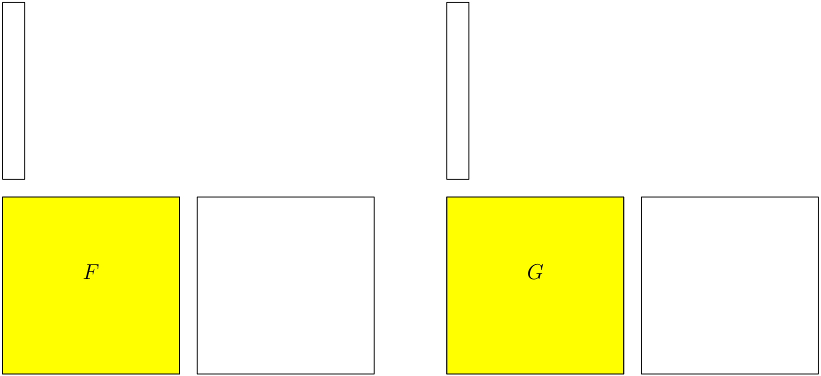
Implicitly dealiased convolutions reduce the cost of zero-padding.

Implicitly Dealiased Convolutions



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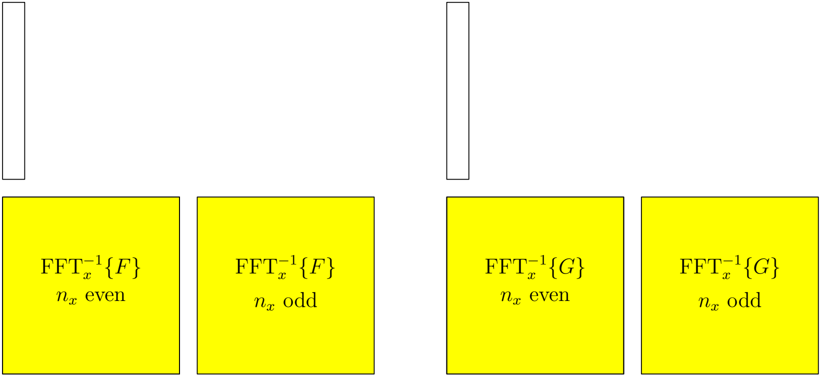

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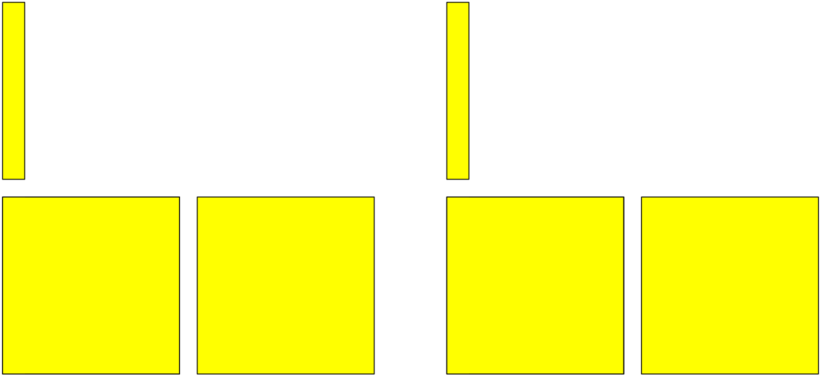

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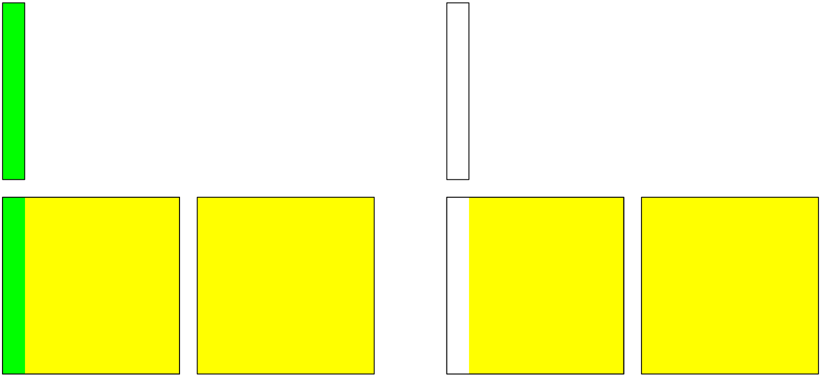

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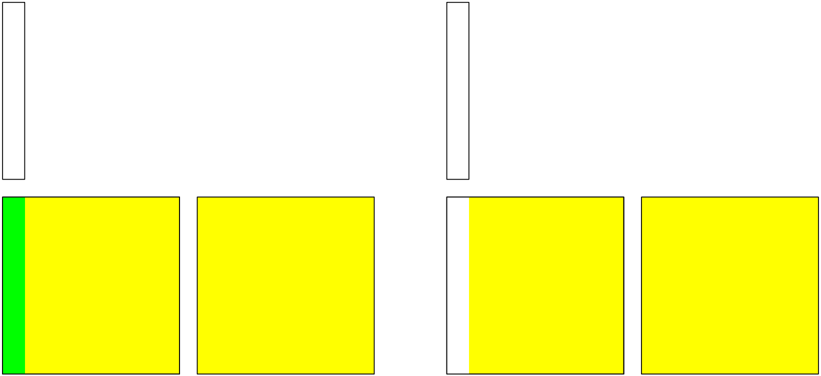

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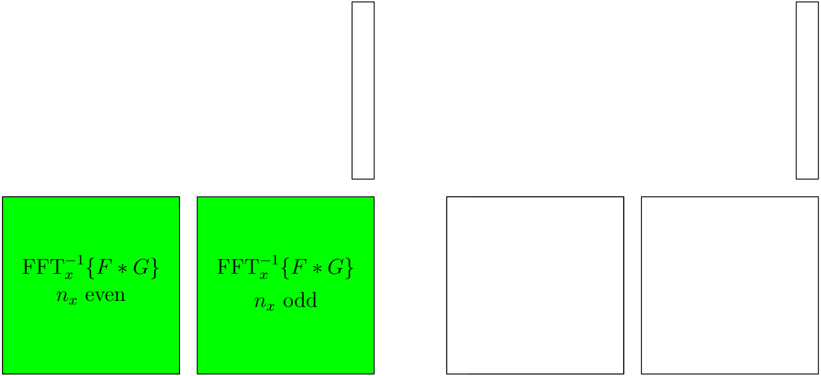

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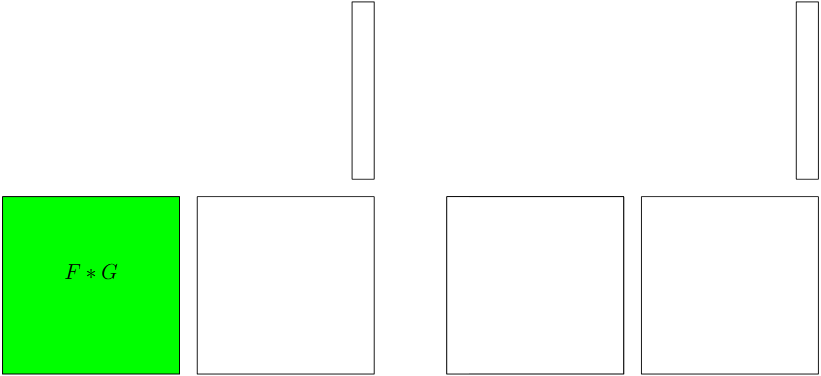

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Penalization allows one to perform simulations with complex geometries using uniform grids.

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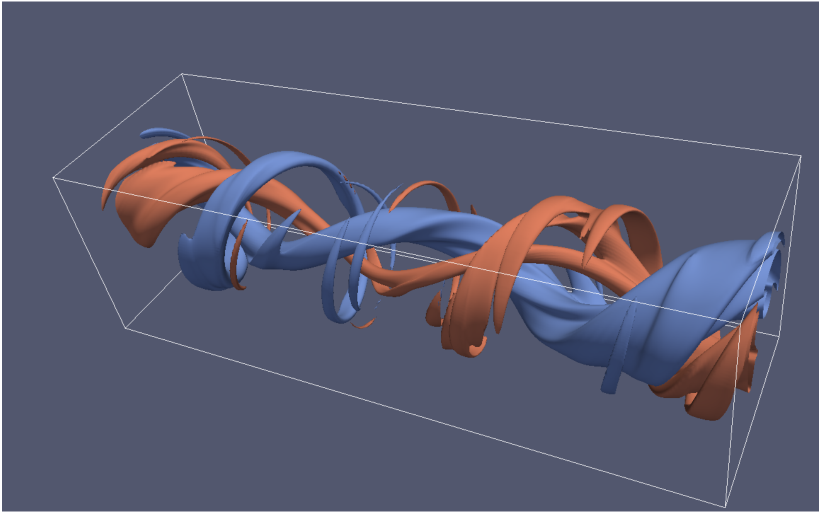

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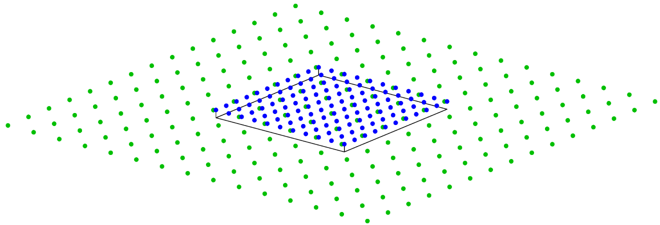

The multispectral method uses a hierarchy of decimated Fourier grids to reduce the number of degrees of freedom.

Proposed Research

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Finish implementation of `fftw++` and use in `flusi` and `CLAC`.

Continue work on multispectral reduction.

Teaching, Outreach, and Service

Teaching:

- Lecturer and Teaching Assistant (Alberta)
- Developed course notes for 2^{nd}-year DEs course.
- Helped supervise PhD and Masters (Aix-Marseille)
- Initiated and organized multi-university post-graduate teaching conference.

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Service:

- Past-president of Math/Stats GSA
- Helped organize several graduate-level conferences.

Publications In Progress

- *Symmetry Breaking and Turbulence Onset in Elliptical Taylor-Couette Flow*
- *Spontaneous Generation of Angular Moment in MHD Flow*
  With Matthieu Leroy and Kai Schneider
- *Implicitly Padded Convolutions and Correlations on Real Data*
- *Parallel Implementation of implicitly padded convolutions*
  With John C. Bowman.
- *Renormalisation Limits of Shell Models of Turbulence*
  With John C. Bowman.

Peer-Reviewed Articles

- *Helically forced MHD flows in confined cylindrical geometries*, 2014
- *Adaptive Matrix Transpose Algorithms for Distributed Multicore Processors*, 2013
- *Multithreaded Implicitly Dealiased Pseudospectral Convolutions*, 2012
- *Pseudospectral Reduction of Incompressible Two-Dimensional Turbulence*, 2012
- *Dealiased Convolutions for Pseudospectral Simulations*, 2011
- *Efficient Dealiased Convolutions without Padding*, 2011
- *Links between dissipation, intermittency, and helicity in the GOY model revisited*, 2006

Software

- `fftw++`
  - Wraps `FFTW` for `C++`
  - Implicitly Dealiased Convolutions
  - Three levels of parallelism: `SSE`, `OpenMP`, `MPI`
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- `tri/goy/dns`
  - Written in `C++`
  - `tri`: A multi-threaded time-stepper.
  - `goy`: Simulations of shell models of turbulence.
  - `dns`: Simulations of 2D Navier–Stokes flow.
  - Includes spectral reduction and multispectral methods.

Thank you

Merci pour votre attention!