Software, complexity & reuse...

Robust-to-experimental codes for geodynamics

CIG-II Planning workshop 200903

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Real world drivers – real science problems
What is it you (the US geodynamics community), wants?
Do we really want to write a new code and re-implement all our assets when a new method comes about?
Separation of concerns... Granularity at the features likely to change

- **Software / Software engineering concerns**
- **Computational / domain concerns**
  - 2D, 3D, free surfaces, AMR, ...
- **Numerical concerns**
  - Multigrid, block solvers, ...
- **Physics concerns**
  - Mohr Columb, MoresiMulhaus, ...
To provide communities with sustainable software infrastructure that can readily adopt new methods & knowledge and be applied to many related problems

This is what StGermain is
For communities, the approach is...

- **Retreats**
  - Get people together, focus on a problem
  - CIG have been good at this
  - “Documentation” is not enough

- **Break out of the mould** – *implement software in the modularity that changes!*
  - The numerical schemes, physics, etc
  - Imagine if you could “trade features”... community created infrastructure

- **Hide parallelism, stitching, etc**
The Underworld platform

- History rich rheologies
- 3D, Parallel, stokes

- Our view: a **platform**
  - Built on StGermain
  - Framework, and a
  - Code

- Long term geodynamics
  - Plate to basin scale

- Rapid adoption of numerical research

- Not traditionally for “end users”
Holden Commodore SS
Australian designed
"Underworld"

Pontiac G8
US branding
"GALE"

• The collaboration: (from the approach...)
  – Take *Underworld* at 2006 (early version)
  – Add **surface processes**, **packaging** & support to the US Community
• It has diverged from the approach
  – Effectively a “fork” (but can be re-merged)
  – We’ve stopped developing features together

• Making it easy to install has been an eye opener!

• Engagement – its not clear to me what the GALE community would see as ideal?
  – How can we help?
MaDDs

- **Driver:** take McKenzie scale magma dynamics into a 3D ridge scale setting
  - **GALE** – community infrastructure driven
  - **MaDDs** – computational challenge “demonstrator”
  - Magma working group, in particular Spiegelman

- Numerically very complicated & difficult

- **Approach:** piecewise capability increment upon Underworld
• Benchmark driven
  – clear deliverables
  – Reused as “unit” test for the science features

• Visits from Marc and Laurent

• Is it all going to come down to preconditioning?
  – What’s the best environment for developing them?
Going forward

• Readily describe bigger and more complicated problems...
  – Continue the Lego pieces of scientific concerns
    • StGermain
  – Describe new problems without C
    • PDE template library
  – Better stitching & less “scariness”
    • StGermain interface has changed since its inceptions
    • Especially wrt HPC directions

• Better provide to the spectrum of users across all the problems
Wrap up

• What do you want?
  – Hopefully I’ve given you a f/w for thinking about it independent of our own technology
  – Sounds like we need a StGermain tutorial/workshop

• CIG2 is poised to provide the software infrastructure

• More scale, more physics, changing HPC landscape
  – Need to manage this! Expensive for CIG or expensive for user-developers?