Disruptive Technologies

Iain Duff

STFC Rutherford Appleton Laboratory and CERFACS

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EESI

The European Exascale Software Initiative completed its report in the autumn of 2011.

A follow-up project called EESI-2, led by Philippe Ricoux of TOTAL, with principal partners TOTAL and PRACE, has recently been funded.

The kick-off meeting was held in Paris on 18th September 2012.

EESI-2

EESI-2 will continue for 30 months until 2015.

Several talks at this meeting are from people involved in EESI-2.

A description of the EESI-2 project can be found through the web page: `www.eesi-project.eu/pages/menu/homepage.php`

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SO

Disruptive Technologies

What does the term Disruptive Technologies mean?

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My intention is to stimulate thought and discussion.

The following notes are constructed after discussions with many colleagues in EESI-2 and beyond.

Some historic disruptive technologies

- Printing press

Some historic disruptive technologies

- Printing press
- Telephone

Some historic disruptive technologies

- Printing press
- Telephone
- Internet

Some historic disruptive technologies

- Printing press
- Telephone
- Internet
- Mobile communications

Some historic disruptive technologies

- Printing press
- Telephone
- Internet
- Mobile communications
- Facebook and twitter

Some historic disruptive technologies in numerical algorithms

- Programmable computers

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- Programmable computers
- Backward error analysis

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- DFT

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- DFP algorithm for optimization

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- Multigrid

Future Disruptive Technologies

Future Disruptive Technologies

Easier to name the Grand National winner

Future Disruptive Technologies

Easier to name the Grand National winner

However, can give some suggestions to provoke the ongoing debate

Disruptive technologies in hardware

It could be argued that the Disruptive Technologies in hardware necessary for Exascale have already happened.

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Multi-core chips

and

GPUs

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Others in pipeline

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Multi-core chips

and

GPUs

Others in pipeline

Stacked memory and

Photonics – optical interconnect

Disruptive technologies in software

- Domain Specific Languages (DSLs)

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- New programming models

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Disruptive technologies in software

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- Tiling
- Memory management
- Automatic vectorization!

Disruptive technologies in algorithms

- Communication reducing algorithms
- Communication hiding algorithms
- Synchronization reducing algorithms

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- Mixed precision computations

Disruptive technologies in algorithms

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- Synchronization reducing algorithms
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- Low rank compression
  - Low rank approximation
  - Fast multipole methods
  - Model reduction
  - Compressed sensing

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- Stochastic PDEs

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- New techniques
  - Tensor calculus
  - Novel algebras
  - Stochastic programming
- "New" algorithms
  - Chaotic relaxation
  - Contour integration
  - Monte-Carlo techniques
  - Vectorization

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- They are usually only recognized as such after the event
- They will be crucial for exploiting Exascale machines
- We might be able to identify some, but where do we get them from?
- One role of EESI-2 experts is to detect and encourage disruptive technologies

THANK YOU FOR YOUR ATTENTION

iain.duff@stfc.ac.uk