Uncertainty:
- Code life cycle measured in decades.
- Architecture & API life cycles measured in Moore doubling periods.
- Example: if you coded for the IBM Cell processor API...

Portability:
- CUDA, OpenCL, OpenMP, OpenACC, Intel TBB, etc are not code compatible.
- Not all APIs are installed on any given system.

Performance*:
- Naively porting OpenMP to CUDA or OpenCL likely will yield low performance.
- Manufacturers devote resources to enhancing specific APIs.

Parallelism*:
- The programmer has to expose parallelism in memory access and operations.

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**Finite Difference OCCA Kernel**

Acoustic Wave Equation
- Simplest wave model

\[ p\frac{\partial u}{\partial t} - c^2 \Delta p = 0 \]

**OCCA**

Existing Approaches to Cross-Platform CUDA
- Current approaches translate CUDA for non-NVIDIA devices
- Translate to OpenCL due to similarity in languages
- GPU-Ocelot translates at the GPU assembly level (PTX, CAL, …)

OCCA: A Unified Approach to Multi-Threading Languages

David Medina*, Amik St-Cyr†, & Tim Warburton*

*Department of Computational and Applied Mathematics, Rice University; †Computation & Modeling, Shell

OCCA Platform and Hardware Pairing
- Unifies heterogeneous platforms by abstracting language APIs
- Takes advantage of the similarity in platform optimization techniques
- Macro-based kernel language masks different supported languages

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**Discontinuous Galerkin seismic forward modeling**

General Conservative-Law Form

\[ \frac{\partial \mathbf{u}}{\partial t} + \mathbf{V} \cdot \mathbf{F} = S \]

For each element:
- Compute divergence at volume node
- Compute flux at surface node

For each surface node:
- Calculate flux contribution at volume node

**Summary**

OCCA-Enabled Applications

- ALMOND
  - Fully accelerated aggregation-based algebraic multi grid
  - MACRO-enabled
  - Spectral overlapping additive Schwarz preconditioner

- RIDG
  - Discontinuous Galerkin seismic forward modeling

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**Project References**