## HIGH PERFORMANCE IMPLEMENTATION AND OPTIMIZATION OF GEOMETRIC MULTIGRID OPERATIONS IN LIFT

Bastian Hagedorn | Martin Lücke | Michel Steuwer





#### **BRIDGING THE ABSTRACTION GAP**



#### **BRIDGING THE ABSTRACTION GAP**



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man



March 1











Application











LIFT











An efficient method to solve Partial Differential Equations (PDE)

Solving PDEs Traditional Approach:



#### **GEOMETRIC MULTIGRID** An efficient method to solve Partial Differential Equations (PDE)

#### Solving PDEs Traditional Approach:







#### **GEOMETRIC MULTIGRID** An efficient method to solve Partial Differential Equations (PDE)

























A

**def** residual = fun(A =>

A)



**def** residual = fun(A =>





**pad**(1,1,*clamp*,A))



 $\downarrow$  pad  $\downarrow$  slide

*slide*(3,1, **pad**(1,1,clamp,A)))





#### 

**↓** map



**def** residual = fun(A => map(computation, *slide*(3,1, pad(1,1,clamp,A))))



Decombose to Re Compose are expressed as compositions of intuitive, generic 1D primitives



map(comp, slide(3,1, pad(1,1,clamp,input)))

are expressed as compositions of intuitive, generic 1D primitives



map\_(comp, slide\_(3,1, pad\_(1,1,clamp,input)))

are expressed as compositions of intuitive, generic 1D primitives



map<sub>3</sub>(comp, slide<sub>3</sub>(3,1, pad<sub>3</sub>(1,1,clamp,input)))

are expressed as compositions of intuitive, generic 1D primitives



map<sub>3</sub>(comp, slide<sub>3</sub>(3,1, pad<sub>3</sub>(1,1,clamp,input)))

Compact Language 📿 Reuse Rewrites 💽 Simple Compilation

Advantages:



#### **EVALUATION - GMG OPERATIONS**



#### **EVALUATION - GMG OPERATIONS**



#### **EVALUATION - COMPLETE V-CYCLE**



#### **LIFT IS OPEN SOURCE!**

# more info at: **lift-project.org Paper** Artifacts Source Code

Bastian Hagedorn: b. hagedorn@wwu.de

