



WESTFÄLISCHE
WILHELMS-UNIVERSITÄT
MÜNSTER

Praktikum: Scientific Computing

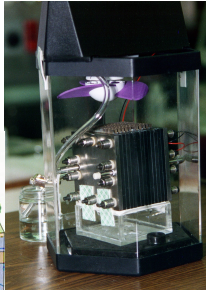
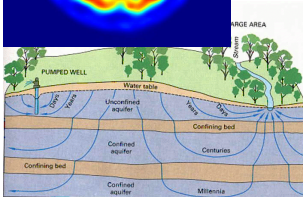
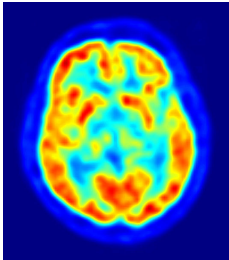
Gängiger Workflow für numerische Simulationen

Probleme, z.B. physik./chem./biol.
Prozesse, Finanzmathematik, ...

Mathematische Modellierung, z.B. Sys-
tem partieller Differentialgleichungen

Diskretisierung, z.B. Finite Elemente Verfahren

Beispiele



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Beispiele



Beispiele

Problem: meist sehr hohe Anforderungen



Hohe Anforderungen an Speicher und Rechenzeit!

Übliche Ansätze für Modellreduktion

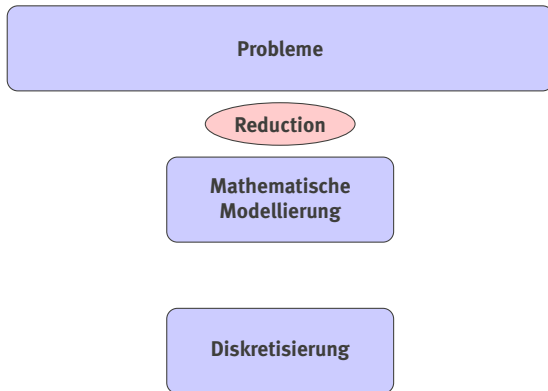
Reduction

Probleme

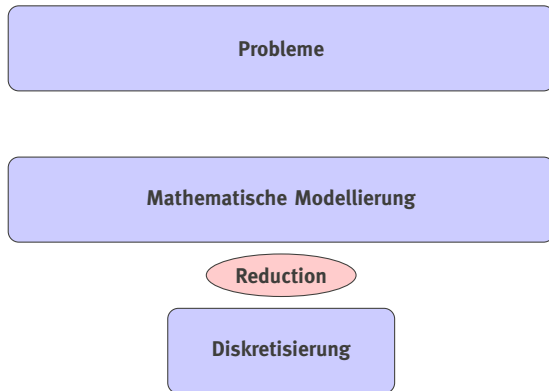
**Mathematische
Modellierung**

Diskretisierung

Übliche Ansätze für Modellreduktion



Übliche Ansätze für Modellreduktion



Dieses Praktikum: Reduzierte-Basis Methode

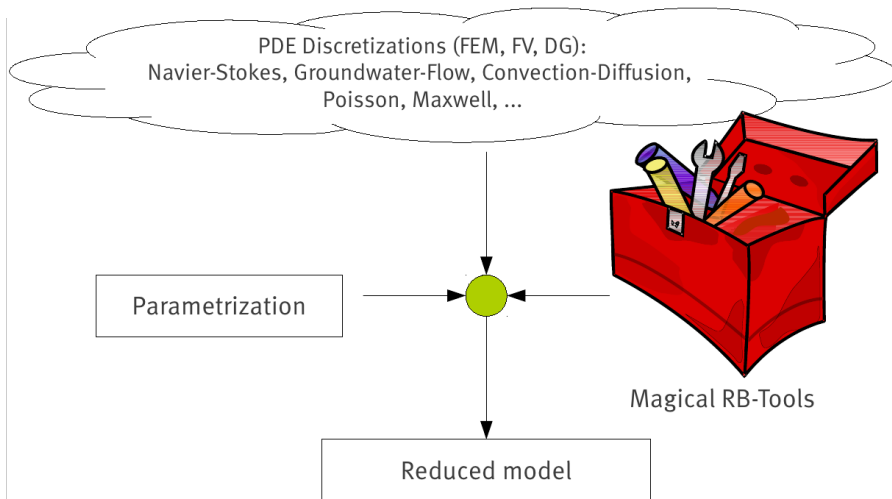
Probleme

Mathematische Modellierung

Diskretisierung

Reduction

Reduzierte-Basis Methode



Motivation: Reduced Basis Method

RB Scenario:

- ▶ Parametrized applications relying on **time-critical** or many **repeated** simulations

Goals:

- ▶ **Offline**-/Online decomposition
- ▶ Efficient reduced simulations
- ▶ A posteriori error control

References: [Patera&Rozza, 2006], [Haasdonk et al., 2008]

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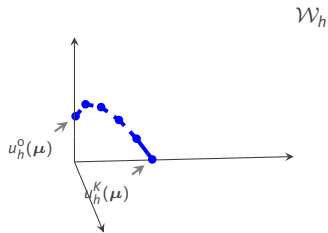
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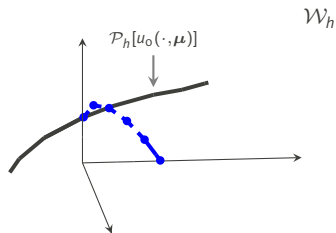
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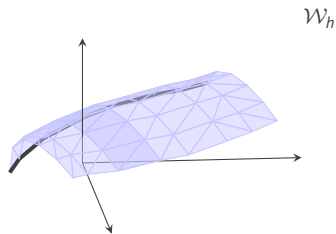
Idea of the Reduced Basis Method



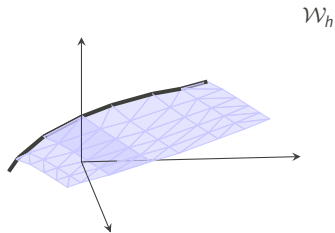
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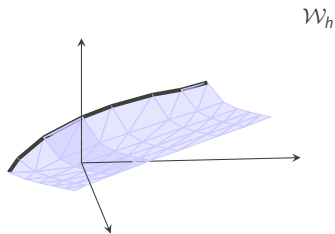
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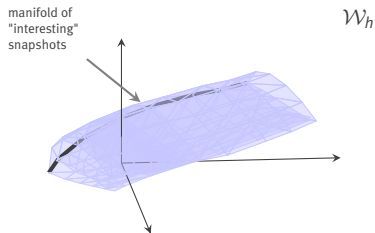
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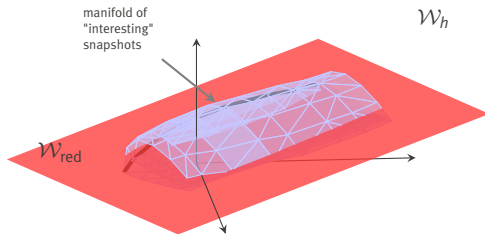
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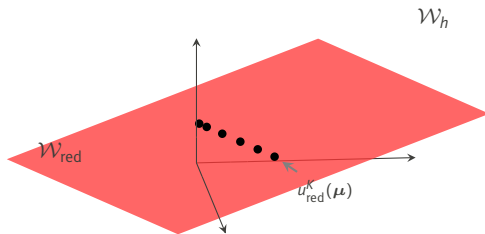
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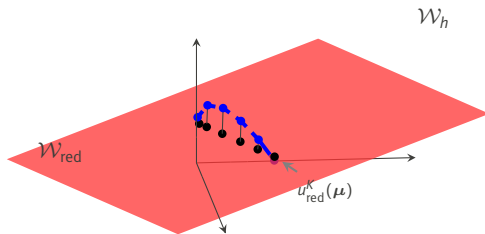
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Praktikumsziele

Kennenlernen und Implementieren von ...

- ▶ gängigen Diskretisierungsverfahren, z.B.
 - ▶ Finite Differenzen
 - ▶ Finite Elemente
 - ▶ Discontinuous Galerkin
 - ▶ ...
- ▶ Parameterisierungen der Modelle,
- ▶ Projektionsverfahren,
- ▶ Reduzierten Simulationen und
- ▶ A-posteriori Fehlerschätzern

Herausforderungen

- ▶ Theorie
 - ▶ Fehlerkontrolle
 - ▶ Effizienzabschätzungen
 - ▶ Nicht-lineare Probleme (Empirische Interpolation)
- ▶ Algorithmen
 - ▶ Effiziente Basisgenerierung (Greedy, POD, p-,t-Partitioning, ...)
 - ▶ Adaptive Bestimmung von parameterabhängigen Modelldaten (SCM)
- ▶ Software
 - ▶ Parallelisierung
 - ▶ Abstraktion für schnelle Erweiterung bestehender Diskretisierungen
 - ▶ (Implementation auf Low-end hardware)