Storyboard Defense Part 1
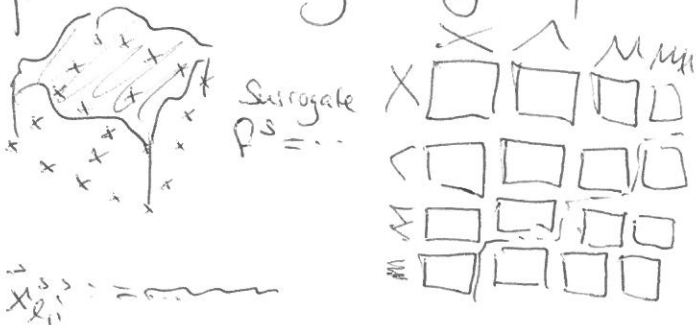
Inverse Problems

| Recipe |
_____
_____

R. Feynman

(1)

Inverse Problems

Forw. Prob.

Param. → Model → Sim.

1

Reality

Inverse problem

Opt. problem:
_____
2

Assumptions:
_____
3

(2)

Sparse Grid Surrogates by Interpolation

Surrogate
$f^S =$ ...

X ∧ M,M,M

$\vec{x}_{\ell,i}^{\vec{s}} :=$ _____

$I_{\ell}^{\vec{s}} :=$ _____

FG/Reg./DA/SA/SG

(3)

B-Splines for Sparse Grids

explain w/ cake

$b^0 :=$ ~
$b^p :=$ ~

2
Advantages:
_____

→ linear

(4)

B-Splines for SGs
Alg. + Appl. to
Higher-Dim Opt.

1. ~
2. ~
3. ~
4. ~

expl. outline with logo

(5)
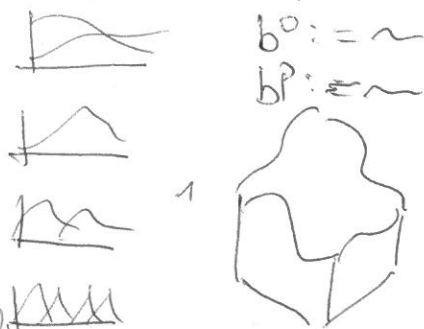
Boundary Behavior and Not-a-Knot B-Splines

1

⊕ $^{11/7}$
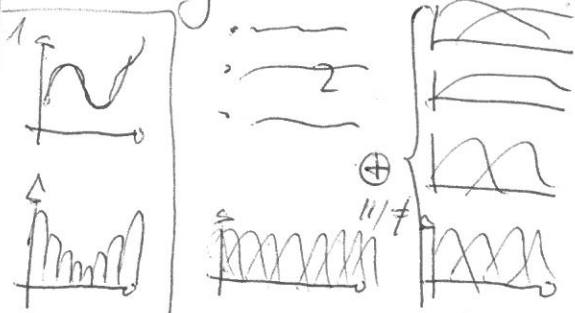
update with NAK

Vazipfl (in preparation)

(6)

Bound. Behavior + NAK B-splines

Legend

linear

standard B-Spl.

1 NAK

Can be combined w/:

Mod.   CC SPS

2   CC Bspl.

Vazipfl (in preparation)

(7)
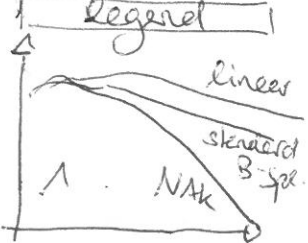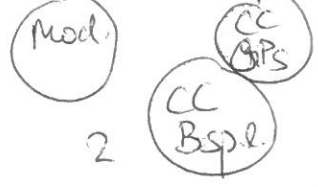
The Hierarchization Problem

$f^S := \sum$ 1

$\sum_{(\vec{\ell},\vec{i}) \in K} \alpha_{\vec{\ell},\vec{i}} \varphi_{\vec{\ell},\vec{i}}(\vec{x}_{\vec{\ell},\vec{i}}^{\vec{s}}) = f(\vec{x}_{\vec{\ell},\vec{i}}^{\vec{s}})$
$(\vec{\ell},\vec{i}) \in K$ (4.1),(4.2)

$\Leftrightarrow \vec{y} = \mathcal{L}[\vec{u}]$ with (4.5)
$\vec{y} = \vec{\alpha}, \vec{u} = f, \mathcal{L} = A^{-1}$

Fig. 4.2. 2

| p=1 | p=3 | p=5 |

A

A^{-1}
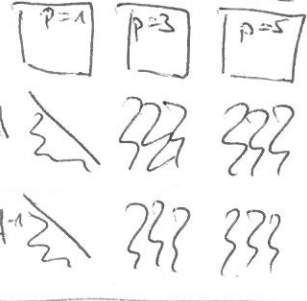
(8)

Storyboard Defense Part 2

Hierarchization on FGrs – UP
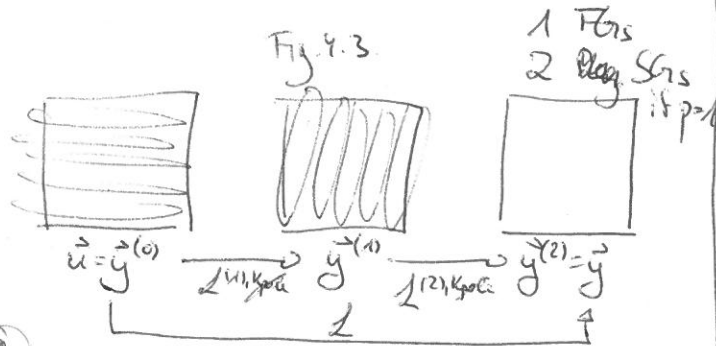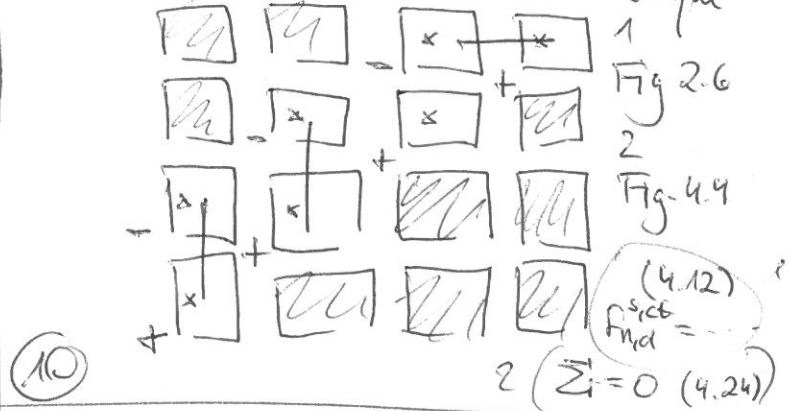
Fig. 4.3

1 FGrs
2 Play SGrs
if p>1

$\vec{u} = \vec{y}^{(0)} \xrightarrow{\downarrow^{(1)}, K\rho\alpha} \vec{y}^{(1)} \xrightarrow{\downarrow^{(2)}, K\rho\alpha} \vec{y}^{(2)} = \vec{y}$

1

2

(9)

Hierarchization on DASGrs – Combi Technique

1
Fig. 2.6

2
Fig. 4.9

(4.12)
sict
$f_{nd} = $

2 ($\Sigma_i = 0$ (4.24))

(10)

Hier. on DASGrs – Residual Interp.

4

0

3

2

1

$\boxed{\times \; \times \; \times}$ update along scheme

(11)

Hier. on SASGrs – ~~Fundamental Bases~~

1 B-spl
3 FS
(med?)
(NAK?)

2
1. AFT
2. TIFT
$\rightsquigarrow$ Fund. splines

BFS ? Fig. 4.7

Fig. 4.6

Fig. 4.5

Fund.spl. proper   P=1   P=3   P=5   2

(12)

Hier. on SASGrs – Unidirection. Princ.
Equivalence and Chains

chain:

$\ell^{(t_d)} \ldots \ell^{(t_1)} \stackrel{?}{=} \ell$

$\Leftarrow\!\Rightarrow$ $\ell^{-1} = (\ell^{(t_1)})^{-1} \ldots (\ell^{(t_d)})^{-1}$

Equivalence : (Cor. 4.25)
1.
2.
3.

(13) Vazirke (in prep.)

Hier. on SASGrs – Unidirection. Princ.
Weakly Fund. Splines and Hermite Hier.

orig
2
p=1
p=3
WF 2

Fig. 4.15

Chain points to be inserted
Fig. 4.14

Hermite Hier.
Fig. 4.17

NAK?

(14) Vazirke (in prep.)
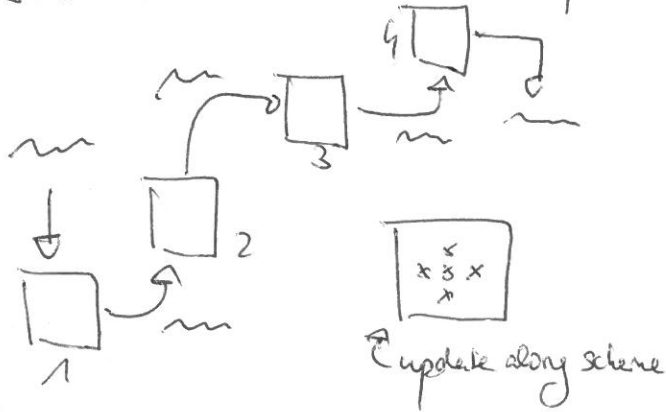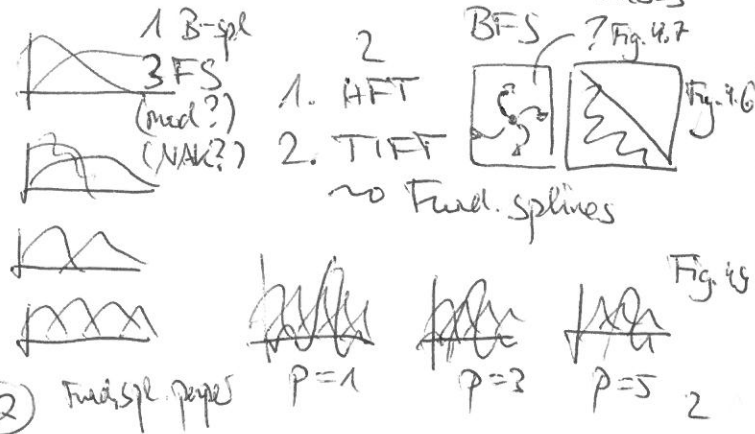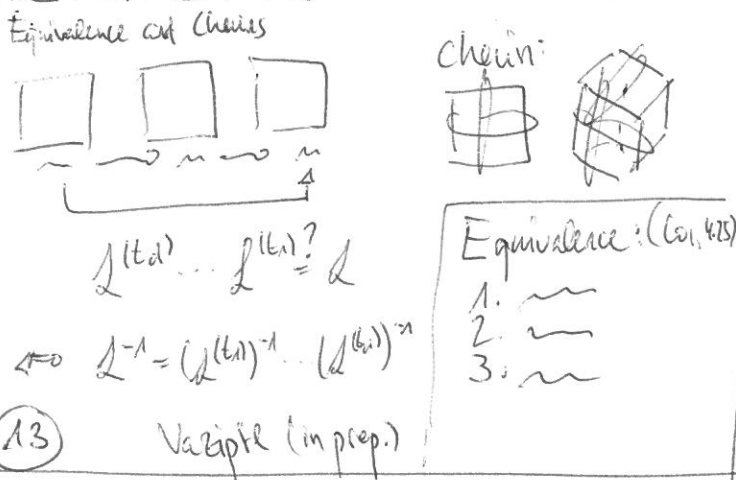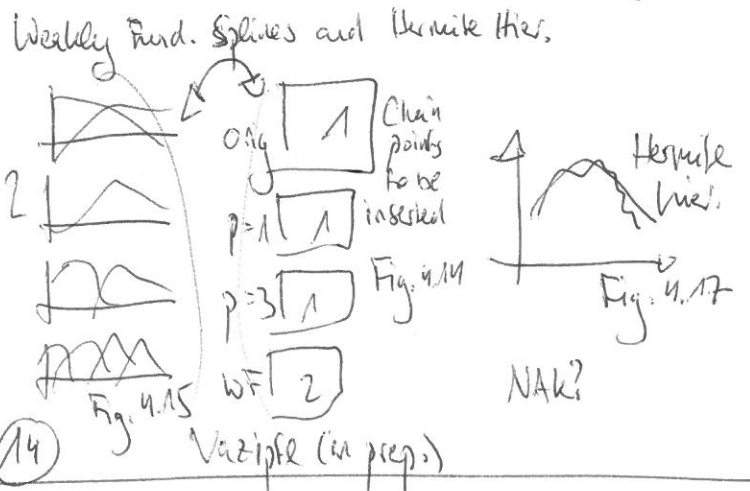
Topology Optimization – Homog. + Two-St.p.

Fig. 6.1

1

(6.1) – (6.3)

Fig. 6.2   2

3

Fig. 6.4

(15)
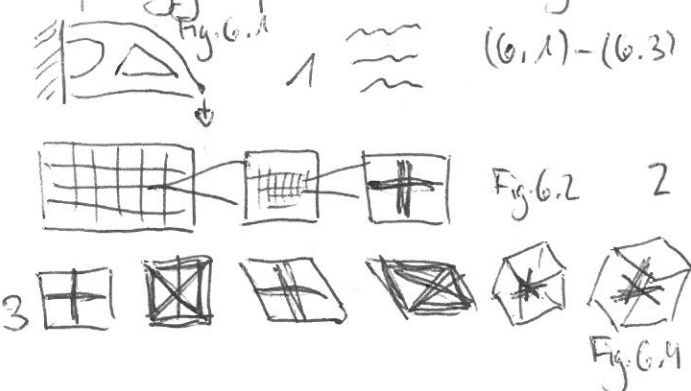
Topol. Opt. – Cholesky Factor Interp.

1   2
$\underline{E} (\rightarrow \underline{R}) \rightarrow \frac{E^s}{R^s}$

Deriv. form. (6.8)

Min. EV

$\vec{x}(k)$ $RS(\vec{x}^{(k)}) / E^s(\vec{x}^{(k)})$

$(\rightarrow E^{chol,s}(\vec{x}^{(k)}))$

$(\rightarrow J^s(\vec{x}^{(k)})$

Fig. 6.6

Fig. 6.3
update with Chol. Fact.
(3 Interp. error, Fig. 6.7??)
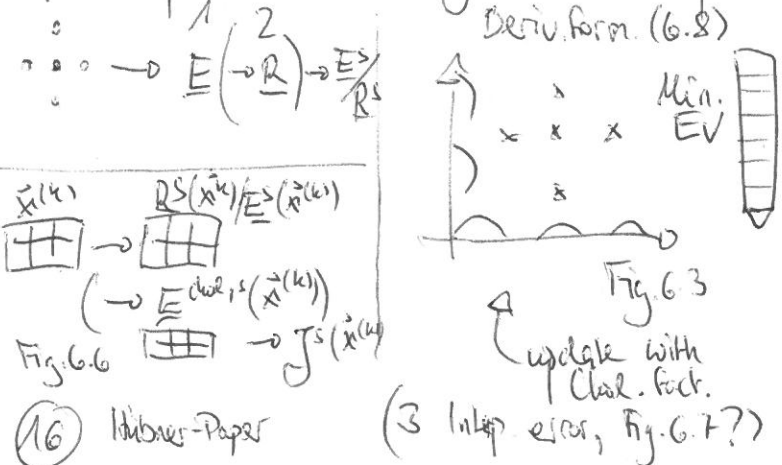
(16) Hübner-Paper

Storyboard Defense Part 3

Topol. Opt. - Numerical Results

1
2
$\times \times \times$
$\times \times$
$\times$
Fig. 6.7

Fig. 6.10

3

Fig. 6.8
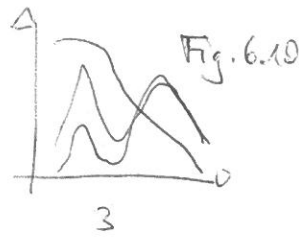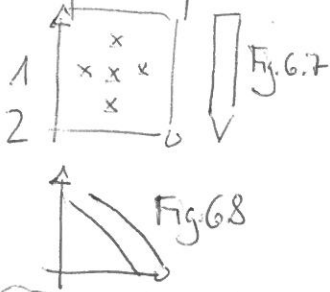
(17) Hübner-Paper

Topol. Opt. - Num. Results

1
Fig. 6.9

2
Fig. C.1
Fig. C.2
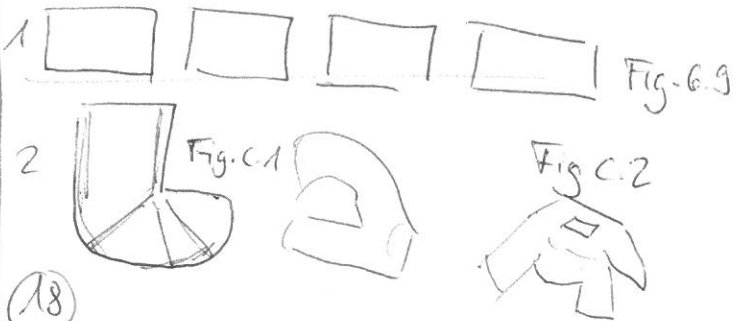
(18)

Dynamic Portfolio Choice Models

t
T

w C_T
w_T

Fig. 8.1

b_{t+1} C_{t+1}
w_{t+1}

b_t C_t
w_t

state X_t policy, stochastic w_t
Bellman eq. (8.4)   1

2

3

y^{opt}_{t+1} iter

X_{t+1}

X_t
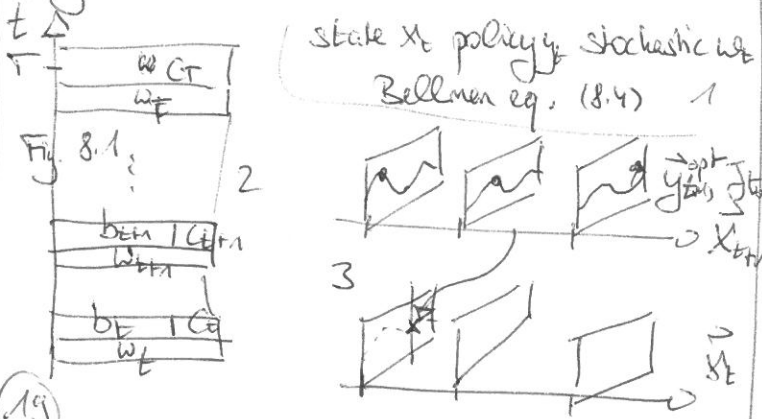
(19)

DPCM - Numerical Aspects

Bellman eq. (8.4)

Fig. 8.2

1   2
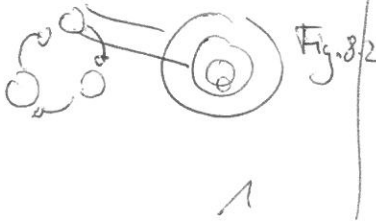
Schober-Paper

State Space
Cropping
Expectation (quadr.)
Extrapolation
Euler errors
CET

(20)

DPCM - Numerical Results

1
Fig. 8.3
2
Fig. 8.5

TCP (#vars)

3
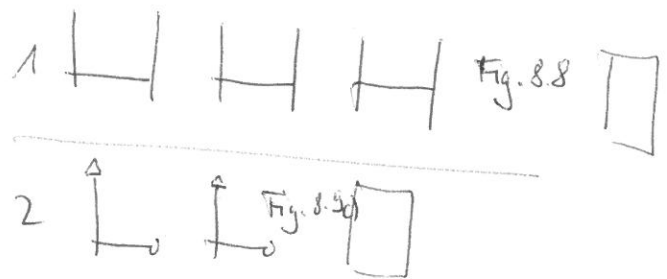Fig. 8.7

Schober-Paper

(21)

DPCM - Numerical Results

1
Fig. 8.8

2
Fig. 8.9

(22)
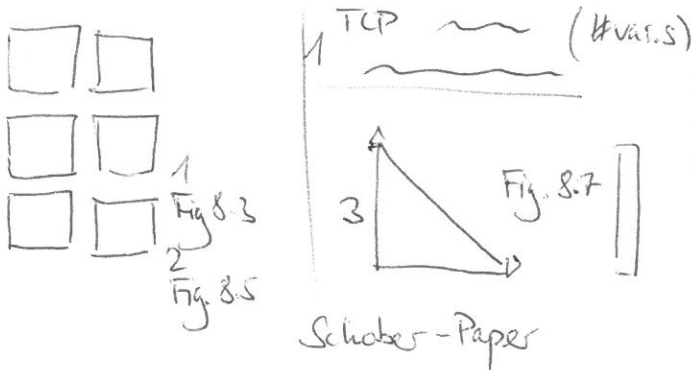
Conclusion and Take-Home Message

· Advantages

∘ Limitations

reference cake recipe from beginning

(23)

Musculoskeletal Models and More in My Thesis

Biomech.

Fuzzy

Test problems

Excerpts from thesis

(24)