

BHYWI-08: Semester-Fahrplan

Vorlesungen

Datum	V	Thema
13.04.2018	01	Einführung / Qt Installation
20.04.2018	02	Grundlagen: Kontinuumsmechanik
27.04.2018	03	Grundlagen: Hydromechanik
04.05.2018	04	Grundlagen: Partielle Differentialgleichungen
11.05.2018	05	Grundlagen: Numerische Methoden
18.05.2018	06	Qt Übung: Funktionsrechner
01.06.2018	06	Numerik: Finite Differenzen Methode I (explizit)
08.06.2018	07	Numerik: Finite Differenzen Methode II (implizit)
22.06.2018	08	Gerinnehydraulik: Theorie – Grundlagen
29.06.2018	09	Gerinnehydraulik: Programmierung, Übung 1
06.07.2018	10	Gerinnehydraulik: Programmierung, Übung 2
13.07.2018	11	Grundwassermodellierung: Datenbasierte Methoden
20.07.2018	12	Beleg

Hydroinformatik II

”Prozesssimulation und Systemanalyse”

BHYWI-08-10 @ 2018

Gerinnehydraulik - Übungen

Olaf Kolditz

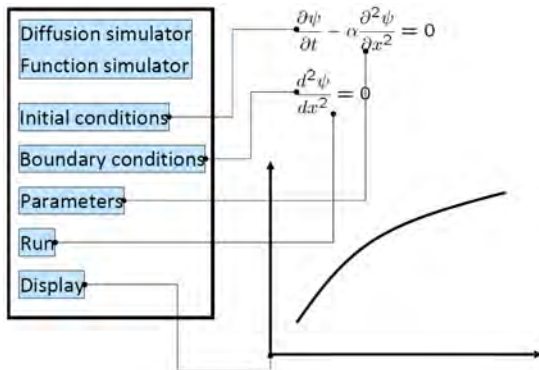
*Helmholtz Centre for Environmental Research – UFZ

¹Technische Universität Dresden – TUDD

²Centre for Advanced Water Research – CAWR

06.07.2018 - Dresden

0 - Zur Erinnerung: ... Konzept und Fazit



Eigenes MatLab ...

- ▶ Funktions-Simulator
FDM Simulator
(explizit und implizit)
- ▶ Newton Simulator
- ▶ ... alles noch 1D,
schau'n wir mal
(Systemanalyse)

0 - Newton-Schritt Simulator

Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Here we can set text ...

Initial conditions

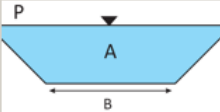
Boundary conditions

Material conditions

Run Newton step

Show results

All-in-one



Initial water level:

Water level boundary:

Channel discharge:

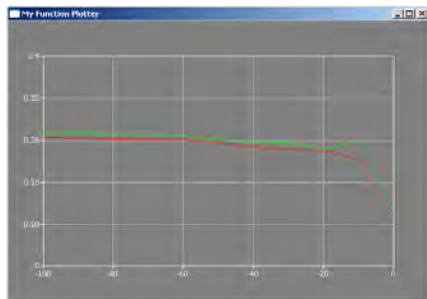
Friction coefficient 1:

Friction coefficient 2:

Bed slope:

Newton error tolerance:

Newton error:



- ▶ **Reminder:**
- ▶ Newton-Schritt Simulator
- ▶ QBasics: QLineEdit
- ▶ Plotter (local / global variables)

1 - Parameter anzeigen #1

Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Here we can set text ...

Initial conditions

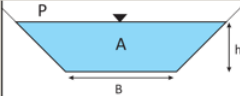
Boundary conditions

Material conditions

Run Newton step

Show results

All-in-one



Initial water level:

Water level boundary:

Channel discharge:

Friction coefficient 1:

Friction coefficient 2:

Bed slope:

Newton error tolerance:

Newton error:

Newton iterations:

- ▶ Tafelbild:
- ▶ Datentransfer
- ▶ Beispiel:
Anfangsbedingungen

1 - Parameter anzeigen #2

```
void Dialog::on_pushButtonIC_clicked()
{
    // Anfangsbedingungen setzen
    for(int i=0;i<n;i++)
    {
        u_old[i] = ICValue;
    }
    // Daten im Dialog sichtbar machen
    sDummy.setNum(ICValue,'f',5);
    lineEditIC->setText(sDummy);
    // Schnick-Schnack
    pushButtonIC->setStyleSheet("background-color: green");
}
```

↔ Important: ICValue

1 - Parameter anzeigen #3

```
void Dialog::on_pushButtonBC_clicked()
{...
    sDummy.setNum(BCValue, 'f', 5);
    lineEditBCR->setText(sDummy);
}

void Dialog::on_pushButtonMAT_clicked()
{
    sDummy.setNum(friction_law_exponent, 'f', 5);
    lineEditFrictionLawExponent->setText(sDummy);
    sDummy.setNum(m, 'f', 5);
    lineEditFrictionCoefficient->setText(sDummy);
    sDummy.setNum.bed_slope, 'f', 5);
    lineEditBedSlope->setText(sDummy);
    sDummy.setNum(discharge, 'f', 5);
    lineEditDischarge->setText(sDummy);
    sDummy.setNum(error_tolerance, 'f', 5);
    lineEditNewtonTolerance->setText(sDummy);
}
```

2 - Iterationszähler #1

Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Here we can set text ...

Initial conditions

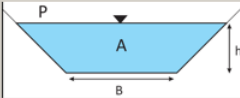
Boundary conditions

Material conditions

Run Newton step

Show results

All-in-one



Initial water level: 0.20000

Water level boundary: 0.15000

Channel discharge: 0.05000

Friction coefficient 1: 0.50000

Friction coefficient 2: 1.00000

Bed slope: 0.00040

Newton error tolerance: 0.00100

Newton error: -0.18206

Newton iterations: 1

- ▶ Wo einbauen?
- ▶ `while()` Schleife

- Implementierung: Welche Funktion(en)?

```
int main(int argc, char *argv[])
```

```
public:
```

```
    Dialog(QWidget *parent = 0);  
    ~Dialog();
```

```
private slots:
```

```
    void on_pushButtonIC_clicked();  
    void on_pushButtonBC_clicked();  
    void on_pushButtonMAT_clicked();  
    void on_pushButtonRUN_clicked();  
    void on_pushButtonALL_clicked();  
    double RUN_NewtonStep();
```

- ▶ Implementierung: while()

```
void Dialog::on_pushButtonALL_clicked()
{...
  float error = 1.1*error_tolerance;
  while(error>error_tolerance)
  {
    error = RUN_NewtonStep();
  }
}
```

2 - Iterationszähler #4

- ▶ Implementierung: Komplett

```
void Dialog::on_pushButtonALL_clicked()
{...
    float error = 1.1*error_tolerance;
    while(error>error_tolerance)
    {
        error = RUN_NewtonStep();
        //Plotter
        QVector<QPointF> points0;
        for(int i=0;i<n-1;i++)
        {
            points0.append(QPointF(x[i],u_new[i]));
        }
        points0.append(QPointF(x[10],u_new[10]));
        plotter->setCurveData(k++, points0);
        plotter->show();
        //Datenübergabe Dialog
        sDummy.setNum(error, 'f', 5);
        lineEditNewtonError->setText(sDummy);
        sDummy.setNum(k,5);
        lineEditIterations->setText(sDummy);
    }
}
```

3 - Fehlerberechnung #1

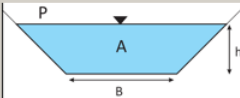
Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Here we can set text ...

Initial conditions
Boundary conditions
Material conditions
Run Newton step
Show results
All-in-one

Initial water level: 0.20000
Water level boundary: 0.15000
Channel discharge: 0.05000
Friction coefficient 1: 0.50000
Friction coefficient 2: 1.00000
Bed slope: 0.00040
Newton error tolerance: 0.00100
Newton error: -0.18206
Newton iterations: 1



- ▶ Warum nur eine Iteration?

```
while(error>error_tolerance)  
{...}
```

```
while(error > error_tolerance)  
{...}
```

$$\varepsilon = \sqrt{\sum_i (h^{k+1} - h^k)^2}$$

```
error = sqrt(error*error);
```

3 - Fehlerberechnung #2

```
while(error>error_tolerance)  
{...}
```

$$\varepsilon = \sqrt{\sum_i (h^{k+1} - h^k)^2}$$

```
error = sqrt(error*error);
```

$$\varepsilon = |h^{k+1} - h^k|$$

```
error = abs(error);
```

3 - Fehlerberechnung #3

Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Here we can set text ...

Initial conditions

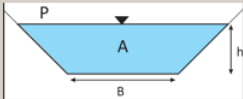
Boundary conditions

Material conditions

Run Newton step

Show results

All-in-one



Initial water level: 0.20000

Water level boundary: 0.15000

Channel discharge: 0.05000

Friction coefficient 1: 0.50000

Friction coefficient 2: 1.00000

Bed slope: 0.00040

Newton error tolerance: 0.00100

Newton error: 0.00080

Newton iterations: 20

► Jetzt klappts.

4 - Parameter ändern #1

- ▶ Erstmal überlegen.
- ▶ ↷ Tafelbild

4 - Parameter ändern #2

Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Initial water level:

Water level bounda:

Here we can set te: Channel discharge:

Initial conditions Friction coefficient 1:

oundary condition Friction coefficient 2:

Material conditions Bed slope:

Newton error tolera:

Newton error:

Newton iterations:

- Layout: Blöd gelaufen.

4 - Parameter ändern #2

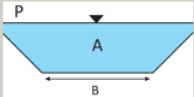
Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Here we can set text ...

Initial conditions
Boundary conditions
Material conditions

Run Newton step
Show results
All-in-one



Initial water level: 0.20000
Water level boundary: 0.15000
Channel discharge: 0.05000
Friction coefficient 1: 0.50000
Friction coefficient 2: 1.00000
Bed slope: 0.00040
Newton error tolerance: 0.00100
Newton error:
Newton iterations:

Change IC value

- ▶ Wo ändern?
- ▶ `w.setFixedWidth(400)`
- ▶ Na also.

```
#include <QLineEdit>

//declaration
QLineEdit* lineEditIC;
//definition
lineEditIC = new QLineEdit();
//use
Get- und Set-Funktionen
```

- ▶ Warum auf ein mal Unterscheidung zwischen Deklaration und Definition?

```
QString ICString = lineEditIC->text()  
double ICValue = lineEditIC->text().toDouble()
```

```
#include <QLineEdit>

//declaration
QLineEdit* lineEditIC;
//definition
lineEditIC = new QLineEdit();
//use
    //set
QString ICString;
ICString.setNum(ICValue, 'f', 5);
lineEditIC->setText(sIC);
    //get
QString ICString = lineEditIC->text()
double ICValue = lineEditIC->text().toDouble()
```

K

5 - Anfangsbedingungen ändern #1 Wie

Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Here we can set text ...

Initial conditions

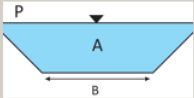
Boundary conditions

Material conditions

Run Newton step

Show results

All-in-one



Initial water level:

Water level boundary:

Channel discharge:

Friction coefficient 1:

Friction coefficient 2:

Bed slope:

Newton error tolerance:

Newton error:

Newton iterations:

Change IC value

► Change IC Value

5 - Anfangsbedingungen ändern #2 Programmierung

Deklaration:

```
class Dialog : public QDialog
{...
private slots:
    void on_pushButtonICChange_clicked();
...}
```

Definition:

```
void Dialog::on_pushButtonICChange_clicked()
{
    QString sICValue = lineEditIC->text();
    ICValue = lineEditIC->text().toDouble();
    for(int i=0;i<n-1;i++)
    {
        u_old[i] = ICValue;
    }
}
```

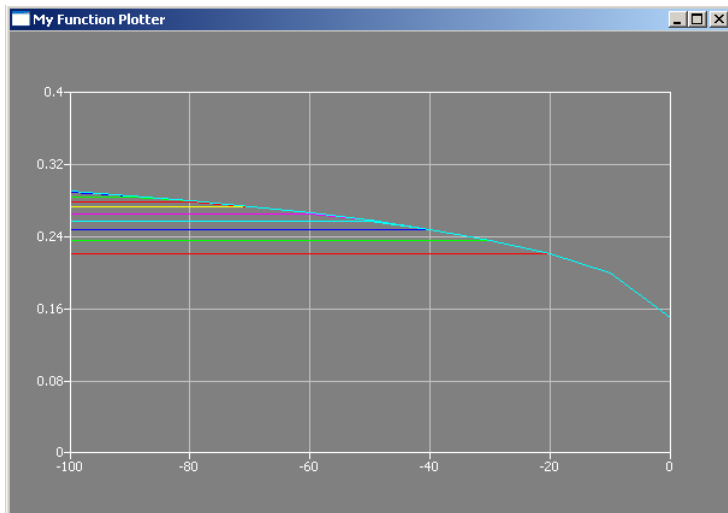

Verknüpfung einer Funktion mit einem Ereignis:

```
connect(pushButtonICChange,  
        SIGNAL(clicked()),  
        this,  
        SLOT(on_pushButtonICChange_clicked()));
```

Typische K-Fragen:

- ▶ Wo werden Member-Funktionen einer Klasse deklariert?
- ▶ Wo werden Member-Funktionen einer Klasse definiert?
- ▶ Schreiben sie die Verknüpfung einer Funktion mit einem Ereignis, wenn eine Schaltfläche gedrückt wurde?

5 - Anfangsbedingungen ändern #3 Analyse



▶ ↪ Run simulation.

6 - Randbedingungen #1

Newton Simulator [?] [X]

Übung E9
Gerinnehydraulik

Here we can set text ...

Initial conditions

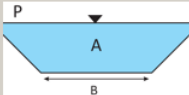
Boundary conditions

Material conditions

Run Newton step

Show results

All-in-one



Initial water level: 0.20000

Water level boundary: 0.30000

Channel discharge: 0.05000 Change IC value

Friction coefficient 1: 0.50000

Friction coefficient 2: 1.00000

Bed slope: 0.00040

Newton error tolerance: 0.00100 Change BC value

Newton error: 0.00099

Newton iterations: 114

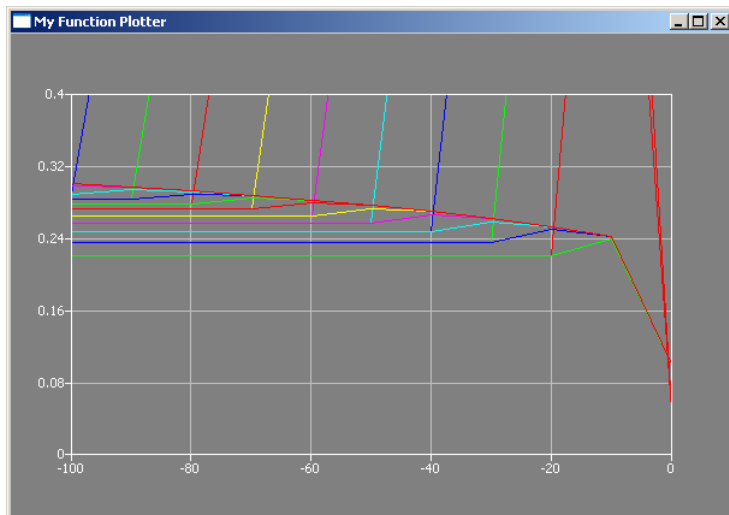
- ▶ the same procedure as ...
- ▶ Wenn Zeit: Implementierung zeigen (step-by-step).

- ▶ Advanced OOP

```
void Dialog::on_pushButtonBCChange_clicked()
{
    QString sBCValue = lineEditBCR->text();
    BCValue = lineEditBCR->text().toDouble();
    on_pushButtonBC_clicked();
}
```

- 1 Funktion deklarieren
- 2 Funktion definieren (leer) [Komplizierbarkeit]
- 3 Funktion schreiben
- 4 Dialogelement anlegen [z.B. Schaltfläche]
 - Element deklarieren
 - Element definieren
 - Element ins Layout einfügen
- 5 Verknüpfung zwischen Funktion und Dialogelement herstellen
- 6 Funktionalität testen
 - Bei Fehlern: Debuggen
 - 2. (verbesserte) Implementierung
 - Namenskonventionen ...

6 - Randbedingungen #2



7 - Discharge #1

- ▶ Nochmal lokale und globale Variablen ...
- ▶ Nochmal, die wichtige Rolle des Konstruktors ...

```
void Dialog::on_pushButtonMAT_clicked()
{...
    //ab in den Konstruktor! discharge = 0.05; // Volumenflie
...}
```

```
Dialog::Dialog(QWidget *parent) : QDialog(parent)
{...
    //hier bin ich glücklich ...
    discharge = 0.05; // Volumenfließrate [m3/s]
...}
```

7 - Discharge #2

Newton Simulator [?] [X]

Teaching OpenGeoSys

Here we can set text ...

Initial conditions

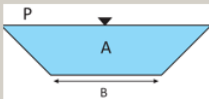
Boundary conditions

Material conditions

Run Newton step

Show results

All-in-one



Initial water level:

Water level boundary:

Channel discharge:

Friction coefficient 1:

Friction coefficient 2:

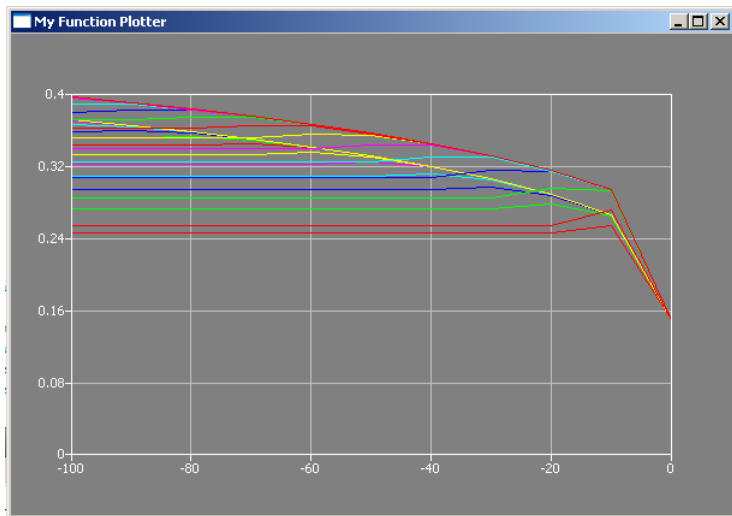
Bed slope:

Newton error tolerance:

Newton error:

Newton iterations:

7 - Discharge #3



8 - Fast fertig #1

Newton Simulator

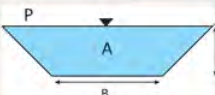
Teaching OpenGeoSys

Here we can set text ...

BHYWI-08: HYDROINFORMATIK II
E8: Newton Simulator

Initial conditions
Boundary conditions
Material conditions

Run Newton step
Show results
All-in-one



Initial water level: 0.20000
Water level boundary: 0.15000
Channel discharge: 0.10000
Friction coefficient 1: 0.50000
Friction coefficient 2: 1.00000
Bed slope: 0.00040
Newton error tolerance: 0.01000
Newton error:
Newton iterations:

Change IC value
Change BC value
Change discharge value
Change friction value
Change bed slope value

Software-Engineering

GitHub

The screenshot shows the GitHub interface for the repository 'envinf / teaching'. At the top, the browser address bar shows 'https://github.com/envinf/teaching'. The repository name is 'envinf / teaching' with 1 Unwatch, 0 Stars, and 0 Forks. Navigation tabs include Code, Issues (0), Pull requests (0), Projects (0), Wiki, Insights, and Settings. A description states: 'This repository is intended for teaching purposes at our partner universities'. Below this, statistics show 3 commits, 1 branch, 0 releases, and 1 contributor. A 'Branch: master' dropdown and a 'New pull request' button are visible. Action buttons include 'Create new file', 'Upload files', 'Find file', and 'Clone or download'. A commit history table is shown below.

Author	Commit Message	Time
OlafKolditz	Update dummy.cpp	Latest commit b6c9194 14 days ago
hydrosystems	Update dummy.cpp	14 days ago
.gitignore	Initial commit	14 days ago
README.md	Initial commit	14 days ago

The screenshot shows the GitHub interface for the repository 'envinf / teaching'. At the top, there is a search bar and navigation links for 'Pull requests', 'Issues', 'Marketplace', and 'Explore'. The repository name 'envinf / teaching' is displayed with statistics: 1 Unwatch, 0 Stars, and 0 Forks. Below this, there are tabs for 'Code', 'Issues (0)', 'Pull requests (0)', 'Projects (0)', 'Wiki', 'Insights', and 'Settings'. A description states: 'This repository is intended for teaching purposes at our partner universities'. Below the description, it shows '6 commits', '1 branch', '0 releases', and '1 contributor'. A 'Branch: master' dropdown and a 'New pull request' button are visible. On the right, there are buttons for 'Create new file', 'Upload files', 'Find file', and 'Clone or download'. The commit history table shows the following entries:

Commit	Message	Time
OlafKolditz	Add files via upload	Latest commit c107675 22 minutes ago
hydroinformatics2	channelflow	Add files via upload 22 minutes ago
hydrosystems		Update dummy.cpp 21 days ago
.gitignore		Initial commit 21 days ago
README.md		Initial commit 21 days ago
README.md		

The screenshot shows the GitHub interface for the repository 'envinf / teaching'. At the top, there is a search bar and navigation links for 'Pull requests', 'Issues', 'Marketplace', and 'Explore'. The repository name 'envinf / teaching' is displayed, along with statistics: 1 Unwatch, 0 Stars, and 0 Forks. Below this, there are tabs for 'Code', 'Issues', 'Pull requests', 'Projects', 'Wiki', 'Insights', and 'Settings'. The current branch is 'master', and the path is 'teaching / hydroinformatics2 / channelflow /'. There are buttons for 'Create new file', 'Upload files', 'Find file', and 'History'. A commit by 'OlafKolditz' is shown, titled 'Add files via upload', with the latest commit hash 'c107679' and a timestamp of '23 minutes ago'. The commit details are as follows:

File	Commit Message	Time
BHYWI-08-08-E.pro	Add files via upload	23 minutes ago
dialog.cpp	Add files via upload	23 minutes ago
dialog.h	Add files via upload	23 minutes ago
main.cpp	Update main.cpp	24 minutes ago
plotter.cpp	Add files via upload	23 minutes ago
plotter.h	Add files via upload	23 minutes ago

BHYWI-08: Semester-Fahrplan

Vorlesungen

Datum	E	Übungen
11.05.2018	01	Qt: Hallo World
11.05.2018	02	Qt: Funktionsrechner
18.05.2018	03	Qt: Explizite Finite-Differenzen-Methode
01.06.2018	04	Qt: Implizite Finite-Differenzen-Methode
15.06.2018	05	Qt: Gerinnehydraulik I (QAD)
22.06.2018	06	Qt: Gerinnehydraulik II (OOP)
22.06.2018	07	Qt: Gerinnehydraulik III (interaktiv)
29.06.2018	08	Qt: Gerinnehydraulik IV (interaktiv)