Proceedings of the RIC Project Day

Workgroup ‘Framework & Standardization’

Frank Kirchner (Editor)
Thomas M. Roehr (Associate Editor)

03/2015
Founded in 1988, DFKI today is one of the largest nonprofit contract research institutes in the field of innovative software technology based on Artificial Intelligence (AI) methods. DFKI is focusing on the complete cycle of innovation – from world-class basic research and technology development through leading-edge demonstrators and prototypes to product functions and commercialization.

Based in Kaiserslautern, Saarbrücken and Bremen, the German Research Center for Artificial Intelligence ranks among the important ‘Centers of Excellence’ worldwide. An important element of DFKI’s mission is to move innovations as quickly as possible from the lab into the marketplace. Only by maintaining research projects at the forefront of science DFKI has the strength to meet its technology transfer goals.

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- Cyber-Physical Systems (Prof. R. Drechsler)
- Robotics Innovation Center (Prof. F. Kirchner)
- Innovative Retail Laboratory (Prof. A. Krüger)
- Institute for Information Systems (Prof. P. Loos)
- Embedded Intelligence (Prof. P. Lukowicz)
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- Language Technology (Prof. H. Uszkoreit)
- Intelligent User Interfaces (Prof. W. Wahlster)
- Innovative Factory Systems (Prof. D. Zühlke)

In this series, DFKI publishes research reports, technical memos, documents (eg. workshop proceedings), and final project reports. The aim is to make new results, ideas, and software available as quickly as possible.

Prof. Wolfgang Wahlster
Director
Proceedings of the RIC Project Day

Workgroup ‘Framework & Standardization’

Frank Kirchner\textsuperscript{(1,2)} (Editor)
Thomas M. Roehr\textsuperscript{(1)} (Associate Editor)

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03/2015

Document D-15-01 des
Deutschen Forschungszentrums für Künstliche Intelligenz (DFKI)
Abstract

This document is the current edition of a publication series which records the topics, discussions and efforts of the workgroups at the DFKI Robotics Innovation Center (RIC). Each edition contains presentation slides and posters of a project day which is organized by two workgroups.

Workgroups provide a platform for cross-project communication and knowledge transfer. They are formed by peers dedicated to a specific topic. Each workgroup has one administrator. In 2008, the workgroups started to present their results and efforts in an open presentation format called brown-bag talk. From 2009 onwards, these presentation were held at so-called project days. Since 2014, a project day consists of two main parts: an oral session and a poster session. Both sessions are documented in a proceedings using the DFKI Document format.

Zusammenfassung

Dieses Dokument enthält die aktuelle Ausgabe einer Tagungsbandserie, welche die Themen, Diskussionen und Bemühungen der Arbeitsgruppen am DFKI Robotics Innovation Center (RIC) protokolliert. Jede Ausgabe enthält Vortragsfolien und Poster eines Projekttages, der von je zwei Arbeitsgruppen gestaltet wird.

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1 Editorial

This is the first edition of 2015 to document the efforts of the DFKI-RIC thematic workgroups on a deep content level and facilitate knowledge transfer amongst the peers. In 2008 we first started forming workgroups on specific topics around robotics and AI research. Among them were topics as ‘system design & engineering’, ‘machine learning’, ‘planning & representation’ as well as ‘frameworks & architectures’ and ‘man-machine interaction’. These workgroups intend to provide a platform for interested DFKI-RIC personnel for discussing the start of the art, recent achievements, and future developments in the respective fields.

This year’s project day season has been opened by the workgroup ‘Framework & Standardization’. This workgroup shows a continuous effort to establish a shared software basis to facilitate the software development for complex robotic systems. To reach this goal it fosters knowledge sharing and code reuse, and establishes standards that lead to workflow optimizations. One intermediate and publicly visible results of this workgroup is its significant contribution to the Robot Construction Kit (Rock) – a framework that is gaining increasing attention even outside of this institute.

Frank Kirchner

This year’s first project day presented the material of the workgroup ‘Framework & Standardization’. The workgroup focuses its efforts on continuously improving the software development workflow and aims at supporting a software framework which fulfills the special needs of developers and systems in the domain of robotics. The workgroup’s primary motivation is to facilitate and accelerate routine tasks and to increase the robustness of the developed software. The workgroup has successfully established the Robot Construction Kit (Rock) as the main in-house development framework which can coexist with the well-known Robot Operating System (ROS).

The presentations of this year deal with technology adoption such as the application of the clang compiler and introduction of HTML5-based interfaces, while presenting the continuous effort of workflow optimization across the toolchain used for robotic software development. While the AG had introduced gitorious to account for a contemporary change towards git software repositories, the need arose for a better workflow for performing pull-requests. This requirement triggered the transition of the internal infrastructure from gitorious to gitlab. Improving user experience has been a driving factor in the past year, i.e., resulting in a robot UI using HTML5 as well as providing a C++-interface as alternative to the existing Ruby-scripting layer for managing Rock software modules. The presentations on ‘constraint-based planning for component networks’ and on ‘a generic description of manipulation behaviour’ illustrate the edge of robotic software development and at the same time the challenges of complex robotic system. The project day concluded with a review of the first workshop series for education of the inhouse Rock community.

I would like to thank all contributors of the first project day 2015 for creating an interesting and informative event.

Thomas M. Roehr
2 ‘Framework & Standardization’

2.1 ‘Introduction’ (FW-T-01)

Thomas M. Roehr(1)

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(2) Universität Bremen, Arbeitsgruppe Robotik, Robert-Hooke-Straße 1, 28329 Bremen, Germany

Contact: thomas.roehr@dfki.de

Abstract

The introduction of this years project day presents the ongoing activities and highlights the past transition from the gitorious-based internal infrastructure to gitlab. Furthermore, a significant achievement has been made with the automated generation of Debian packages for Rock.
Project Day 2015
AG Framework and Standardization

Introduction by ‘Kümmerer’ Thomas M. Roehr

DFKI Bremen & Universität Bremen
Robotics Innovation Center
Director: Prof. Dr. Frank Kirchner
www.dfki.de/robotics
robotics@dfki.de

Outline

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Snack at Empore

www.dfki.de/robotics
Infrastructure changes

- Rock: moved from gitorious -> github
- Inhouse: moved from gitorious-based infrastructure to gitlab
  - spacegit -> git.hb.dfki.de

Testing phase

- Debian packages for Rock
  - Setup: Jenkins based build server
Ongoing activity

- Improving systems management
  - mainly 'syskit'
    - aiming to improve modularization
    - simplification and easing development of 3rd party tools
  - Phase I: detailing status quo and gathering of requirements for improvement (Team)
  - Phase II: developing proposal for workflow and spec (Power Users)
  - Phase III: discussion and review with external developers (Team+Externals)
  - Phase IV: specification (Power Users)
  - Phase V: reference implementation (TBD)

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Snack at Empore
2.2 ‘Current software development at DFKI’ (FW-T-02)

Jakob Schwendner(1)

(1) DFKI GmbH, Robotics Innovation Center, Robert-Hooke-Straße 1, 28359 Bremen, Germany

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Abstract

The talk gives an overview of the current software development activities at the DFKI. A vision is formulated for the direction of the collaborative development efforts. The current tools in use are presented, and social aspects highlighted. Finally, a summary of future activities is given which will likely play an important role in development activities of the RIC.
Software Development at the DFKI

Why?

• 128 Staff at RIC and AG Robotik
• 79 create software

Seems important!
Vision

„Back in [...] everyone was working together on one large svn“

• Be efficient and effective as a group
• Enjoy developing our software

Efficiency & Effectiveness

“Efficiency is doing things right, while effectiveness is doing the right things.”

• Do the work that is needed
• Prevent doubling of work
• Make parts work together

Require Interaction
Method

- Technical Aspects
- Awareness of social aspects
- Identification of groups
- Seize opportunities for joint work

Technical Aspects

- Languages
  - VHDL
  - C
  - C++
  - Ruby
  - Python
  - M
  - R
- Repositories
  - SVN
  - SpaceGit
  - Github
- Documentation
  - /indexing
  - TRAC
  - Gitlab / Github
  - Doxygen etc.
  - Mailing lists
- Quality Control
  - Coding Standards
  - CI build server
  - Code Reviews
  - Merge requests
Framework

• Collection of tools, conventions and communication
• Ratio of algorithm to framework code
• Getting the data where it should be is actually the hard task
• They create work, they restrict...
• ... they allow you to reuse and interface.

Social Aspects

• Not invented here
• Works for me
• I never finish anythi
• The grass is always greener...
• Exploration / Exploitation
• Respect
• Collaboration
• Group Communication
• Say Nay
Groups

• System Builders
• Embedded Processing
• Simulation
• Control
• Interaction
• Navigation
• Autonomy
• Learning
• Planning
• Processing
• Perception

Opportunities for Collaboration

• New Projects
  – Entern (Navigation, Interaction, Simulation)
  – DRock (Processing, Autonomy)
  – VIPE (System Builder, Control, Navigation)
  – ...

2 ‘Framework & Standardization’
Rock Umbrella

• Robot Construction Kit
  – Tooling
    • Building, introspection, modelling, ...
  – Collection of libraries
  – Component Framework (Orcos)
• Rock Foundation

Challenges

• Robot Operating System
  – Dedicated OS for robots (ESA RCOS, EU)
• Model driven robot development
  – Robot descriptions (SMURF), behaviour modelling, mission description
• Tool Support
  – Mission definition, robot design (e.g. Cad2Sim)
2.3 ‘LLVM/clang and libTooling – C++ for machines’ (FW-T-03)

Martin Zenzes(1)

(1) DFKI GmbH, Robotics Innovation Center, Robert-Hooke-Straße 1, 28359 Bremen, Germany

Contact: martin.zenzes@dfki.de

Abstract

LLVM/clang and the associated libTooling provide a flexible API for semantic processing of C/C++ source-code. After introduction of the LLVM/clang ecosystem, this talk will present an overview of existing tools available in Debian/Ubuntu as well as means to create new ones.
LLVM/Clang and libTooling – C++ for machines

Martin Zenzes
martin.zenzes@dfki.de

Projectday – Framework AG

March 19, 2015

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Existing Tools
   Source code analysis
   Automatic modifications

Abstract Syntax Tree

libTooling
   Compiling LLVM/Clang from source
   Refactoring Tool
   Compiler Plugin
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Introduction

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libTooling
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Refactoring Tool
Compiler Plugin

Motivation
yet another talk on frameworks

- C/C++ is very complex, and it evolves
- Mortal humans need centuries to grasp it
- Wouldn’t it be nice to get help from machines?

Disclaimer:
- Sorry for too much Shell and C++ ; - )
Motivation
yet another talk on frameworks

- C/C++ is very complex, and it evolves
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- Wouldn’t it be nice to get help from machines?

Disclaimer:
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LLVM/Clang
introduction

- Extensive framework for processing and compiling Code
- Modern, object-oriented C++ with public API
- Permissive license: MIT/BSD
- Roughly 6 month release cycle:
  - 2007 First public release
  - 2010 Self hosting
  - 2012 Primary compiler in FreeBSD
  - 2013 C++14 feature complete
  - February 27, 2015 LLVM/Clang 3.6

RMS is pissed
LLVM/Clang ecosystem

- Frontend, Optimizer, Backend...
- Framework of complementary libraries: *libTooling*
- Dynamic plugin interface
- Used in many free and commercial tools
- Releases available in distributions:
  - Debian Wheezy 3.1
  - Debian Jessie 3.4 – 3.7 (co-installable!)
  - Ubuntu 12.04 3.0, 3.3, 3.4
  - Ubuntu 14.04 3.3 – 3.5
  - Windows 3.4 – 3.7

LLVM Weekly

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Compiler Plugin
**clang**

compiler warnings

```c
#include <stdlib.h>

bool isInRange(float frstAngle, float scndAngle) {
    // check if the error is smaller than "epsilon"
    if (abs(frstAngle - scndAngle) < 0.005f)
        return true;
    return false;
}
```

user@host:~$ clang -fsyntax-only isInRange.cpp

isInRange.cpp:5:9: warning: using integer absolute value function 'abs' when argument is of floating point type [-Wabsolute-value]
    if (abs(frstAngle - scndAngle) < 0.005f)
        ~

isInRange.cpp:5:9: note: use function 'std::abs' instead
    if (abs(frstAngle - scndAngle) < 0.005f)
    ^--
    std::abs

isInRange.cpp:5:9: note: include the header <cmath> or explicitly provide a declaration for 'std::abs'
1 warning generated.
clang
applying fixits

▶ Can make trivial changes automatically (and continue)

1 template <class T> class Impaired {
2     T var;
3   };
4
5 class Impaired<int>;

user@host:~$ clang -fsyntax-only -fixit tmpl_fixit.cpp

.../tmpl_fixit.cpp:5:7: error: template specialization requires 'template<>'
class Impaired<int>;
  ~~~~~

template<>
.../tmpl_fixit.cpp:5:7: note: FIX-IT applied suggested code changes

1 template <class T> class Impaired {
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clang
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clang
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`template<>`  
`.../tmpl_fixit.cpp:5:7: note: FIX-IT applied suggested code changes`

```cpp
template <class T> class Impaired {
  T var;
};
template<> class Impaired<int>;
```

clang-check
static analysis

- Static analyzer performs control-flow based analysis
- Knows macros, variable values, type system, branching, ...

```cpp
#define WEIRDO(a, b) ((a) / (b))

int harmless(int z) {
  if (z == 0) {
    return WEIRDO(1, z);
  }
  return 1 + z;
}
```

user@host:~$ clang-check weirdo.cpp -analyze --

`.../weirdo.cpp:5:16: warning: Division by zero
return WEIRDO(1, z);
^~~~~~~~~~~`  
`.../weirdo.cpp:1:27: note: expanded from macro 'WEIRDO'
#define WEIRDO(a, b) ((a) / (b))
```

1 warning generated.
clang-check
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#define WEIRDO(a, b) ((a) / (b))
~~~~^~~~~
1 warning generated.
```

clang-modernize

- Migrating source code to C++11
- UseNullptr, PassByValue, ReplaceAutoPtr, ...
- Risk-levels: safe, reasonable, risky

```c
#include <vector>
#include <iostream>

void nullptr_assignment() {
  char *a = NULL;
  char *b = 0;
  char c = 0;
}

void loop_convert(std::vector<int> v) {
  for (std::vector<int>::iterator it = v.begin(); it != v.end(); ++it)
    std::cout << *it;
}
```
clang-modernize

- Migrating source code to C++11
- UseNullptr, PassByValue, ReplaceAutoPtr,...
- Risk-levels: safe, reasonable, risky

```cpp
#include <vector>
#include <iostream>

void nullptr_assignment() {
  char *a = nullptr;
  char *b = nullptr;
  char c = 0;
}

void loop_convert(std::vector<int> v) {
  for (auto & elem : v)
    std::cout << elem;
}
```

clang-format

whitespace fixes

- Automatic formatting based on semantic analysis
- Different coding styles, configurable .clang-format

```cpp
#include <sstream>
#define PURE_HORROR(scare) \
  std::stringstream ss; \ 
  ss << "omg, this '"" is horrible. run!""; \ 
  throw(ss.str())

class TC { double interestingName(const int *rumba, int * bumba) \
  { if (bumba)
    return *rumba**bumba-1.f;
  else PURE_HORROR(* rumba);}};
```
clang-format
whitespace fixes

▶ Automatic formatting based on semantic analysis
▶ Different coding styles, configurable .clang-format

user@host:~$ clang-format kaputt.cpp -style=Google

```
#include <sstream>
#define PURE_HORROR(scare) |
    std::stringstream ss; |
    ss << "omg, this " << scare << " is horrible. run!"; |
    throw(ss.str());

class TC {
    double interestingName(const int *rumba, int *bumba) {
        if (bumba)
            return *rumba * *bumba - 1.f;
        else
            PURE_HORROR(*rumba);
    }
};
```

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clang-format
whitespace fixes

▶ Automatic formatting based on semantic analysis
▶ Different coding styles, configurable .clang-format

user@host:~$ clang-format kaputt.cpp -style='{BasedOnStyle: Google,SpacesInParentheses: true,IndentWidth: 3}'

```
#include <sstream>
#define PURE_HORROR(scare) |
    std::stringstream ss; |
    ss << "omg, this " << scare << " is horrible. run!"; |
    throw(ss.str());

class TC {
    double interestingName(const int *rumba, int *bumba) {
        if (bumba)
            return *rumba * *bumba - 1.f;
        else
            PURE_HORROR(*rumba);
    }
};
```

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2.3 ‘LLVM/clang and libTooling – C++ for machines’ – Martin Zenzes

Contents

Introduction

Existing Tools
Source code analysis
Automatic modifications

Abstract Syntax Tree

libTooling
Compiling LLVM/Clang from source
Refactoring Tool
Compiler Plugin

Abstract Syntax Tree
not GIMPLE

- Clang’s intermediary data structure, e.g. for optimizations
- Closely resembles written C++ source
- Central part of libTooling
- Traverseable via API: getTranslationUnitDecl()
- AST Nodes: DeclStmt, BinaryOperator, ParenExpr, IntegerLiteral, ImplicitCastExpr,...

Introduction to Clang AST
clang-check
inspecting the AST

- Dumping coloured AST (pipe into less -R)
- Helps debugging clang-related tooling

```c
/** with doxygen comment attached */
int doubleItUp(int myArg) {
  return 2 * myArg;
}
```

user@host:~$ clang-check simple-func.cpp -ast-dump --

TranslationUnitDecl 0x2d889f0 <<invalid sloc>> <invalid sloc>
  | TypedefDecl 0x2d88f30 <<invalid sloc>> <invalid sloc> implicit __int128_t '__int128'
  | TypedefDecl 0x2d88f90 <<invalid sloc>> <invalid sloc> implicit __uint128_t 'unsigned __int128'
  | TypedefDecl 0x2d89390 <<invalid sloc>> <invalid sloc> implicit __builtin_va_list '__va_list_tag [1]'
  | FunctionDecl 0x2d894e0 <.../simple-func.cpp:2:1, line:4:1> line:2:5 doubleItUp 'int (int)'
  | ParmVarDecl 0x2d89420 <col:16, col:20> col:20 used myArg 'int'
  | CompoundStmt 0x2d89630 <col:27, line:4:1>
    | ReturnStmt 0x2d89610 <line:3:5, col:16>
    | BinaryOperator 0x2d895e8 <col:12, col:16> 'int' '*'
      | IntegerLiteral 0x2d89588 <col:12> 'int' 2
    | ImplicitCastExpr 0x2d895d0 <col:16> 'int' 'ValueToRValue'
      | DeclRefExpr 0x2d895a8 <col:16> 'int' lvalue ParmVar 0x2d899d8 'myArg' 'int'
    | FullComment 0x2d896f0 <line:1:4, col:34>
      | ParagraphComment 0x2d896c0 <col:4, col:34>
        | TextComment 0x2d89690 <col:4, col:34> Text=" with doxygen comment attached "
```

clang-check
inspecting the AST

- Dumping coloured AST (pipe into less -R)
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      | ParagraphComment 0x2d896c0 <col:4, col:34>
        | TextComment 0x2d89690 <col:4, col:34> Text=" with doxygen comment attached "
```
AST Matcher

- Hierarchy modelled via inheritance of Classes → usage of C++ type system
- Template based API to locate specific Nodes
- Very powerful; very complex

```cpp
// matches 'int b[7]' for example
arrayType(hasElementType(builtinType()))

// match records named 'Foo' that are derived from 'Bar'
recordDecl(hasName("Foo"), isDerivedFrom("Bar")).

// matches 'int x = 0' in
// for (int x = 0; x < N; ++x) {} 
forStmt(hasLoopInit(declStmt()))
```

clang-query

- Interactive interpreter for AST Matcher expressions
- Just discovered while preparing this talk...

```cpp
int foo(int* p, int v) {
    if (*p == 0) {
        return v + 1;
    } else {
        return v - 1;
    }
}
```

```bash
clang-query> match varDecl().bind("var")
Match #1:
ifexx.c:1:9: note: "var" binds here
int foo(int* p, int v) {
    ^~~~
Match #2:
ifexx.c:1:17: note: "var" binds here
int foo(int* p, int v) {
    ^~~~
2 matches.
```
libTooling
what can we do with this?

LLVM/Clang and libTooling for programmatic access to C++!

- Policy: reformatting, generating documentation, verification
- IDE: code completion, moving around, pulling in definitions
- Refactoring: Renaming variables, evolving APIs
- Dynamic tools: JIT, interpreter, generating code, language-to-language translation
- Less boilerplate: Writing one-off tools to scratch your itch

Contents

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LLVM/Clang

obtaining the source

- Officially SVN, mirrored to git
- Independent buildsystems: autotools and cmake
- Stick to directory convention
- Buildsystem will pick up additional subfolders

```
user@host:~$ REL=release_36
user@host:~$ URL=http://llvm.org/git
user@host:~$ DST=$HOME/llvm.git
user@host:~$ INST=$HOME/llvm.install
user@host:~$ BLD=$DST/build
user@host:~$ git clone --branch $REL $URL/llvm.git $DST
user@host:~$ git clone --branch $REL $URL/clang.git $DST/tools/clang
user@host:~$ git clone --branch $REL $URL/clang-tools-extra.git \
    $DST/tools/clang/tools/extra
```
LLVM/Clang

Testing the result

Configure optimized build, install to $HOME

```
user@host:~$ mkdir -p $BLD && cd $BLD
user@host:~/llvm.git/build$ cmake .. -DCMAKE_INSTALL_PREFIX=$INST \ 
   -DCMAKE_BUILD_TYPE=Release -DLLVM_TARGETS_TO_BUILD="X86"
user@host:~/llvm.git/build$ make all install
```

Check that it actually works

```
user@host:~$ export PATH=$INST/bin:$PATH
user@host:~$ which clang
.../llvm.install/bin/clang
user@host:~$ clang --version
clang version 3.6.1 (http://llvm.org/git/clang.git 1d3945d684dbc51b...)
Target: x86_64-unknown-linux-gnu
Thread model: posix
```
Refactoring Tool
using AST Matchers

- Create CMakeLists.txt and main.cpp in clang/tools/clang
- Subclass MatchFinder::MatchCallback, implement run()
- Create CommonOptionsParser and RefactoringTool
- Register with MatchFinder, call runAndSave()

```cpp
class MyIfStmtHandler : public MatchFinder::MatchCallback {
    private:
        Replacements *Replace;
    public:
        MyIfStmtHandler(Replacements *Replace) : Replace(Replace) {} 
        virtual void run(const MatchFinder::MatchResult &Result) {
            // Implementation
        }
};
```

```bash
# since we are inside the LLVM-tree cmake picked up this macro before
add_clang_executable(
    if-refactor-tool
    main.cpp
)

# to obtaining libraries for this list see "llvm-config"
target_link_libraries(
    if-refactor-tool
    clangEdit clangTooling clangBasic clangAST clangASTMatchers)
```
Refactoring Tool
using AST Matchers

- Create CMakeLists.txt and main.cpp in clang/tools/clang
- Subclass MatchFinder::MatchCallback, implement run()
- Create CommonOptionsParser and RefactoringTool
- Register with MatchFinder, call runAndSave()

```cpp
virtual void run(const MatchFinder::MatchResult &Result) {
  // The matched 'if' statement is bound to 'myIdent'
  if (const IfStmt *IfS = Result.Nodes.getNodeAs<clang::IfStmt>("myIdent")) {
    const Stmt *Then = IfS->getThen();
    Replacement Rep(*(Result.SourceManager), Then->getLocStart(), 0,
                    "/* the 'if' part */ ");
    Replace->insert(Rep);
  }
  if (const Stmt *Else = IfS->getElse()) {
    Replacement Rep(*(Result.SourceManager), Else->getLocStart(), 0,
                    "/* the 'else' part */ ");
    Replace->insert(Rep);
  }
}
```

// Giving our tool a name and description
```cpp
static llvm::cl::OptionCategory ToolingSampleCategory(
  "if-refactor-tool",
  "This tool provides better comments in if-else-thingys");
int main(int argc, const char **argv) {
  // Provides parsing of standard commandline arguments, like "-help"
  CommonOptionsParser op(argc, argv, ToolingSampleCategory);
  RefactoringTool Tool(op.getCompilations(), op.getSourcePathList());
}```
Refactoring Tool
using AST Matchers

- Create CMakeLists.txt and main.cpp in clang/tools/clang
- Subclass MatchFinder::MatchCallback, implement run()
- Create CommonOptionsParser and RefactoringTool
- Register with MatchFinder, call runAndSave()

```cpp
// Set up AST matcher callbacks.
MyIfStmtHandler MyHandlerForIf(&Tool.getReplacements());
MatchFinder Finder;
// Create AST-Matcher for “ifStmt” and bind to given identifier
Finder.addMatcher(ifStmt().bind("myIdent"), &MyHandlerForIf);
// Run the tool and collect a list of replacements. We could call
// run(), which would only collect the replacements.
if (int Result = Tool.runAndSave(newFrontendActionFactory(&Finder).get())) {
    return Result;
}
```

Profit!

```
int foo(int* p, int v) {
    if (*p == 0) {
        return v + 1;
    } else {
        return v - 1;
    }
}
```
Compiler Plugin

$DST/tools/clang/examples/PrintFunctionNames

- Printing global declarations per compile unit
- Based on ASTConsumer
- Loaded as additional pass during compilation process
- Could stop the compilation – enforce policy

```cpp
class PrintFunctionsConsumer : public ASTConsumer {
public:
  virtual bool HandleTopLevelDecl(DeclGroupRef DG) {
    for (DeclGroupRef::iterator i = DG.begin(), e = DG.end(); i != e; ++i) {
      const Decl *D = *i;
      if (const NamedDecl *ND = dyn_cast<NamedDecl>(D))
        llvm::errs() << "top-level-decl: \"" << ND->getNameAsString() << "\n";
    }
    return true;
  }
};
```

```
/** with doxygen comment attached */
int doubleItUp(int myArg) {
  return 2 * myArg;
}
```

```bash
user@host:~/llvm.git/build$ make PrintFunctionNames
user@host:~$ export LD_LIBRARY_PATH=$BLD/lib:$LD_LIBRARY_PATH
user@host:~$ clang -Xclang -load -Xclang PrintFunctionNames.so -Xclang -plugin -Xclang print-fns -fsyntax-only simple-func.cpp
```

Questions? Remarks?
Videos

Some full-hour talks on YouTube:

▶ The Clang AST - a tutorial
▶ clang-format - Automatic formatting for C++
▶ Clang MapReduce - Automatic C++ Refactoring at Google Scale
▶ Interactive Metaprogramming Shell based on Clang
▶ Rebuilding Debian with LLVM/Clang
▶ Integrating LLVM into FreeBSD

LLVM/Clang

Runtime tooling

Runtime instrumentation by clang with additional Sanitizer:
▶ AddressSanitizer – Fast memory error detector
▶ ThreadSanitizer – Detects data races
▶ LeakSanitizer – Memory leak detector
▶ MemorySanitizer – Detects reads of uninitialized variables
▶ UBSanitizer – Detects undefined behaviour

Other runtime tooling:
▶ lldb – LLVM-based debugger
▶ lld – early stage of a new Linker
lldb

- Replacement for GDB, based on libTooling
- Standard in OS X, mostly supports Linux/FreeBSD
- Python and C++API
- Much faster with similar syntax/features

```
user@host:~$ lldb ./build/myTest

# start execution with argument
(lldb) process launch -- -myArg=2
# display 'this' when stopping in 'class myClass'
(lldb) target stop-hook add --classname myClass --one-liner "frame variable *this"
# Show mixed source and disassembly of current line
(lldb) disassemble --frame --mixed
```

clang-tidy

- Enforce coding style, more tests than clang-check
- Compile with own checks, including -fixits
- Config file: .clang-tidy, in closest parent-dir of src-file
- Allows to ignore specific lines, enable/disable checks

add your own checks
2.4 ‘Using Pull Requests on GitHub - Experience report’ (FW-T-04)

Steffen Planthaber(1)

(1) DFKI GmbH, Robotics Innovation Center, Robert-Hooke-Straße 1, 28359 Bremen, Germany

Contact: steffen.planthaber@dfki.de

Abstract

Pull request are an essential part of a developer workflow when interacting with git software repositories. This presentation contains an experience report on how to work with pull requests on github.com. Furthermore, it shows to use this functionality to improve the overall code quality by using it for continuous code reviews.
Using Pull requests on GitHub
Experience Report

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Pull Request

• Ask a package maintainer to add code
  • Send cpp files
  • Patches
  • Pull Requests (merge requests)

• Pull request are the best option
  • Code can be reviewed
  • Diffs are created and can vie viewes
    • And also commented/discussed
How to create one

- You need a branch!
  - In the main repository
  - Or in a „fork“
- A fork copies a repository into another account
  - It keeps the reference to the original repository

Work on the branch

- Add your fork as remote
  - `git add remote myfork PUSH_URL`
  - `git checkout –b myPRbranch`
  - `git commit –m"added feature" -a`
  - `git push myfork myPRbranch`
- One branch/pull request per Feature
  - „master“ branch <= do not use
  - „devel“ for development
    - Several pull request branches
    - One branch per pull request!
Start Pull Request

- You need one branch per pull request!
- Select the PR branch in the main view
- Hit the green button

- Select branches to merge (if not correct)

Discuss the Changes

- The maintainer can now:
  - Comment or ask questions
    - On the PR in general
    - On specific code lines
    - Accept the PR and merge via the PR page on github
- You can
  - Reply
  - Push to the PR branch to update the PR
    - Important: You need to comment on the PR to notify
    - No mail is send on branch update!

- https://github.com/planthaber/rock-webapp/pull/17
Merged!

Merged myself!

Possibilities

- PRs are offering the possibility for code reviews

- They can be used for code reviews
  - „When in doubt, use a PR“
  - Or by default
    - Two users with write access on one repository
    - Only pull requests used for changing master
    - Shared dev branch, or separate ones
Tips

- The „hub“ command
  - „gem install hub“
    - hub pull-request: Open a pull request on GitHub
    - hub fork: Make a fork of a remote repository on GitHub
    - hub create: Create this repository on GitHub
    - Browse: Open a GitHub page in the default browser

- Do not develop on master
- One branch per feature/PR
- When needed, one dev branch which includes all PRs
  - Develop on dev branch, cherry pick to PRs

Thank you!

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2.5 ‘Rocks new http-based API for robot control’ (FW-T-05)

Steffen Planthaber\textsuperscript{(1)}

\textit{(1) DFKI GmbH, Robotics Innovation Center, Robert-Hooke-Straße 1, 28359 Bremen, Germany}

Contact: steffen.planthaber@dfki.de

Abstract

This presentation introduces the new HTTP API of Rock, which provides dependency-less control of rock-based robots since no rock installation needed for control. It also introduces HTML5-based software using the new API to interact with robots from any smart device or tablet.
Rock's new HTTP-based API
for robot control

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Why a new API

- Need to control robots without installing Rock
  - External Partners
  - Devices that can't run rock (windows, phones, etc.)

- Requirements
  - Write to ports
  - Read ports
  - Control syskit actions

- Not supported (yet)
  - Create connections
Types and Protocol Selection

- Types need to be transferred via custom connection
  - Several specifications
    - Protocol Buffers
    - Corba IDL
    - JSON
  - The connections need a protocol
    - Options:
      - TCP/IP
      - Websockets
      - Higher level protocol with return values?
    - Selected JSON, http, and optional Websockets
      - Any browser can use the API!

Examples

```c
int main(int argc, char** argv){
  websp: http://
  const char* url = "http://192.168.151.17:9292/api/robotizations/move_to_defs stere":
  std::cout "http post(\"value\"="\"x\"=1,\"y\"=2\")\" << std::endl;
  return 0;
}
```
API

- The web sites must be provided by the api to work
  - Separated into two packages
    - tools/rest_api
    - gui/webapp
  - The API is reachable under
    - localhost:9292/api/
      - localhost:9292/api/tasks/ <- task related API
      - localhost:9292/api/syskit/ <- syskit related API
  - The UI is reachable under
    - Paged included from gui/webapp
    - localhost:9292/ui/
      - localhost:9292/ui/tasks/ <- task related UIs
      - localhost:9292/ui/syskit/ <- syskit related UIs

How to use the API

- Start the API Server with „rock-webapp“
  - Optionally use --enable-syskit for syskit control

- Open localhost:9292 in a Browser
  - Some examples are given
  - All API values are returned in JSON
    - Some browsers have JSON viewer plugins
  - All ports are readable this way:
Ways to access the API

- Using a browser
  - No writing, when the plain API is used (needs POST)

- Using CURL and a command line
  - Request: curl http://localhost:9292/api/syskit/jobs
  - Write: curl -X POST -H "Content-Type: application/json" -d '{"id":9}' http://localhost:9292/api/syskit/jobs/kill

- Using libcurl in a program

libcurl

- Bindings for libcurl:
  - Ada95, Basic, C, C++, Ch, Cocoa, D, Dylan, Eiffel, Euphoria, Falcon, Ferite, Gambas, glib/GTK+, Guile, Haskell, ILE/RPG, Java, Lisp, Lua, Mono, .NET, node.js, Object-Pascal, OCaml, Pascal, Perl, PHP, Postgres, Python, R, Rexx, Ruby, Scheme, S-Lang, Smalltalk, SP-Forth, SPL, Td, Visual Basic, Visual FoxPro, Q, wxWidgets, XBLite

- Supported OS (binary packages):
  - AIX, AmigaOS, Apple iOS, BeOS, Chrome NaCl, DOS, DragonFly BSD, FreeBSD, GNU-Darwin, Haku, HPUX, Hurd, IRIX, various Linux, Android, Mac OS X, Midnight BSD, Atari MVT, NetBSD, NetWare, Nexenta, Open Server, OpenBSD, OS/2, Plan9, Q

- Orocos_http for cpp is under development
Orocos.js

- "Stop" example using orocos.js (JSON via websocket)
  ```html
  <script>
    function init()
    {
      var controller = orocos.NameService.get("controller");
      var m2dport = con.port;
      var writer = m2dport.writer
    }
  </script>
  <body onload=init()>
  <img src="stop.png" onclick="writer.write(0)"/>
  </body>
  ```

Webapp

- Orocos.js is a basic interface for ports only
- The api also allows getting task information, run states, etc.
- Code to interact with these is located in the
  - gui/rock-webapp package
Conclusion & Future work

• Conclusion
  • Slow for big data types -> binary mode
  • Need to start the server

• Future
  • Connect/disconnect ports?
  • CPP version of orocos.js

Thank you!

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2.6 ‘Constraint-based planning of component networks’ (FW-T-06)

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Abstract

This presentation gives an overview of the ongoing work regarding constrained-based planning of component networks. This work aims at a better introspection and a more formalized way to handle component networks.
Constraint based Planning of Component Networks

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CBP of CN: Status Quo

• Current solution: Syskit/Roby
  • Model-based
  • Event-based
    • e.g.: Behavior change is caused by occurrence of data(-patterns)
  • Planning is done during runtime when a event occurs, consists of
    • Network Resolution
    • Transaction Calculation
  • „Plan“ for a network is calculated for one point in time
  • Support for sequences is also based on the event system
    • Syntactic sugar: „ActionScripts“, „StateMachines“
CBP of CN: Status Quo

- Model-based (Syskit's way)
  - Each abstract requirement has to be resolved to one concrete implementation
  - Ambiguities can occur during network-resolution but also in configuration requirements
  - Each ambiguity has to be resolved manually by the Network Designer
  - It is not possible to have kind of „preferred“ or „weighted“ requirements like „I prefer a sensor fusion, but an IMU would be fine too“
CBP of CN: Status Quo

- Event-based

PipelineDetector
State: follow → PipelineDetector
State: Pipe_Lost

“Mission” modeling

Transition:
- pipeline_follower.failed_event
- wall_following

On pipe_lost_event do
emit failed_event end

Change in state causes:
Pipe_Lost_Event

Calculates the complete network for
wall_following. This includes the resolution of
all abstract requirements.

Network
- Task
- Connection
2.6 ‘Constraint-based planning of component networks’ – Matthias Goldhoorn

**CBP of CN: Status Quo**

- **Runtime Transition Planning**
  
  Transition:
  
  ```
  pipeline_follower.failed_event, wall_following
  ```

  - launch wall_following
  - connect camera_prosilica wall_detector
  - connect wall_detector wall_follower
  - connect wall_follower controller
  - stop pipeline_detector
  - stop pipeline_follower
  - start wall_detector, wall_follower

**CBP of CN: Status Quo**

- **Runtime Transaction Planning**
  - Requires knowledge about both networks
  - ‘Merges’ the new requirements (like wall_following) into the current network
  - Checks whether a network can be found or not
  - Could be the case if some algorithms are not installed or some tasks are already used
  - Or if some configurations could not be applied because another sub-network requires a different setup
CBP of CN: Status Quo

- Mission modeling
- Is based on „events“
  - Like pipeline_lost event, it results in a behavior change to wall_following
  - Only „syntactic sugar“ around event-handling system

CBP of CN: Summarize

- All of the calculations are „Syskit Internal“
- (Ongoing work for modularization in Framework AG)
- All calculations are done during runtime
  - Network Resolution
  - Network Transition Planning
  - Event observation
- Modeling errors cause often runtime problems
  - (partially checking during modeling but not complete)
- System behavior is Event-based
  - Events are a finite and known
- Ambiguities have to be resolved by the Designer
CBP of CN: Wishlist I

- Clear interfaces and additional tools for interim results
- Networks
- Transactions
- Pre-process as many as possible
  - All events are known → all reactions are known
  - Results in strong knowledge about the system behavior
  - Complete behavior can be pre-calculated
  - All transactions and networks can be pre-processed and introspected
...

CBP of CN: Wishlist II

- Automatic handling of ambiguities
- Can result in multiple valid networks
  - Quality of a solution should be computable
  - Idea: If multiple solutions are available and equivalent, it is not important which gets selected
  - Assumption: this makes the reuse in larger systems easier
- Solutions can/must be „constraint“ to gain only valid results
- If time is taken into account, multiple paths could be calculated
- Often several algorithms are available, if one is failing then automatically select another one
- Planning of component networks and missions are converge to each other
CBP of CN: Future Outcome

- Mission validation

```
Start       Goal
10           60
50           20
60           80
50           20
60           30
50           50
50           50

Value: Network Transition over time with rating of network
```

CBP of CN: Future Outcome

- Ambiguity handling

```
Start       Goal
10           60
50           20
60           80
50           20
60           30
50           50
50           50
```
CBP of CN: Future Outcome

- Introspection of transitions and networks (not only requirements)

```
launch wall_following
connect camera_prosilica wall_detector
connect wall_detector wall_follower
connect wall_follower controller
stop pipeline_detector
stop pipeline_follower
start wall_detector,wall_follower
```

CBP of CN: Future Outcome

- Simpler reuse of components
  - Constraint based instead full-defined
  - Results in ability to have a more-lose coupling
  - Reduces the time to get new systems running
  - Enables the definition of more complex systems (preferred requirements)
- Stronger modularization
  - Better introspection
  - Mission evaluation
  - Easier to implement additions
- Pre-computation makes the system react faster
  - Addition extensions could make it real time
CBP of CN: Summary

- Solution might replace Syskit/Roby but keep general idea of modeling
- Makes the system more understandable and verifiable
- Reduce complexity, keep planning and runtime separated
- Allows more complex design at the same time reduce overhead by „designing“ new systems
- Ability to have automatic fallback behaviors without the need of explicit defining them

Thank you!

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Abstract

This presentation gives an overview of the Orocos CPP client library. The library allows direct access and management of oroGen-based components from C++. It intends to provide an alternative to the existing Ruby-Interpreter-based orocos.rb interface.
Orocoss CPP: A C++ client layer for RTT
Janosch Machowinski

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Outline

Orocoss CPP

Deployments

Runtime
Section 1

Orcos CPP

- A C++ alternative to orcos.rb
- Provides:
  - Deployment start/stop
  - Task control (start/configure/stop...)
  - Bundle support
  - Configuration support
  - Transformer support
  - Logging support
Section 2

Deployments

Default deployments:

```
Spawner &spawner(Spawner::getInstance());

// Args: TaskModel, instanceName
spawner.spawnTask("hokuyo::Task", "hokuyoc");

// Only do this ONCE after all deployments have been spawned
spawner.waitUntilAllReady(
    base::Time::fromSeconds(2.0));
```
Deploysments

How to start deployments

Custom deployments:

```cpp
Spawner &spawner( Spawner::getInstance() );
spawner.spawnDeployment("mars_core");

// Only do this ONCE after all deployments
// have been spawned
spawner.waitForAllReady(
    base::Time::fromSeconds(2.0));
```

Custom deployments with rename:

```cpp
Spawner &spawner( Spawner::getInstance() );
Deployment marsCore("mars_core");

// rename mars to simulation
marsCore.renameTask("mars", "simulation");
spawner.spawnDeployment(marsCore);

// Only do this ONCE after all deployments
// have been spawned
spawner.waitForAllReady(
    base::Time::fromSeconds(2.0));
```
Section 3

Runtime

How to get a task proxy

```cpp
#include <hokuyo/proxies/Task.hpp>

hokuyo::proxies::Task *hokuyo( 
    new hokuyo::proxies::Task("hokuyo"));

hokuyo.configure();
    hokuyo.start();
```
Runtime

How to configure a task

```cpp
#include <hokuyo/proxies/Task.hpp>
#include <croccs_cpp/ConfigurationHelper.hpp>

hokuyo::proxies::Task *hokuyo(
    new hokuyo::proxies::Task("hokuyo"));

ConfigurationHelper helper;
helper.applyConfig(hokuyo, "default",
    "special");
hokuyo.configure();
hokuyo.start();
```

Runtime

How to configure the Transformer

```cpp
#include <hokuyo/proxies/Task.hpp>
#include <croccs_cpp/TransformerHelper.hpp>

hokuyo::proxies::Task *hokuyo(
    new hokuyo::proxies::Task("hokuyo"));

smurf::Robot &robot(smurf::Robot::
    loadFromSmurf("robot.smurf"));

TransformerHelper trHelper(robot);
trHelper.configureTransformer(hokuyo);
```
Runtime
How to connect two tasks

```cpp
#include <hokuyo/proxies/Task.hpp>
#include <laser_filter/proxies/Task.hpp>

hokuyo::proxies::Task hokuyo("hokuyo");
laser_filter::proxies::Task filter("filter_front");
hokuyo.scans.connectTo(filter.scan_samples);
```

Runtime
How to get a Reader

```cpp
#include <hokuyo/proxies/Task.hpp>

hokuyo::proxies::Task hokuyo("hokuyo");
RTT::InputPort<base::samples::LaserScan>
    &reader(hokuyo.scans.getReader());

base::samples::LaserScan sample
while(reader.read(sample) == RTT::NewData)
{
    // process
}
```
Runtime

How to get a Writer

```cpp
laser_filter::proxies::Task filter(  
    "filter_front";

RTT::OutputPcrt<base::samples::LaserScan>  
    &writer(filter.scan_samples.getWriter());

base::samples::LaserScan sample  
writer.write(sample);
```

Runtime

How to access properties

```cpp
laser_filter::proxies::Task filter(  
    "filter_front";

double val = filter.maxIncline.get();  
filter.maxIncline.set(5.0);
```
Runtime

How to activate Logging

```cpp
#include <croccs_cpp/LoggingHelper.hpp>

LoggingHelper lHelper;
lHelper.logAllTasks();
```

Runtime

How to activate Logging

```cpp
#include <croccs_cpp/LoggingHelper.hpp>

laser_filter::proxies::Task filter("filter_front");

LoggingHelper lHelper;
lHelper.logAllPorts(filter, "LoggerInstancName");
```
Runtime

How iterate all running Tasks

```cpp
#include <crocs_cpp/NameService.hpp>
#include <crocs_cpp/CorbaNameService.hpp>

CorbaNameService ns;
ns.connect();

std::vector<std::string> tasks = 
    ns.getRegisteredTasks();
```
Abstract

In this talk a framework to design and control robot manipulation behavior is presented. To remain independent from particular robot hardware and an explicit area of application, an embedded domain specific language (eDSL) is applied to describe the particular robot and a controller network that drives the robot. We make use of a) a component-based software framework (Rock), b) model-based algorithms for motion- and sensor processing representations, c) an abstract model of the control system, and d) a plan management software, to describe a sequence of software component networks that generate the desired robot behavior.
On robot-independent manipulation behavior description

Malte Wirkus
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Outline
- Introduction
- Robot Manipulation Behavior Generation
- Control system specification
- Manipulation behavior specification
- Discussion
Introduction

- Robotic software frameworks
  - Define common component interface
    - Increase reusability of software
  - Tools for software development
    - Increase in developer’s productivity
  - Access to large pool of software components
  - Robot programming: Increasingly software integration and configuration task

[ROS](http://www.ros.org)

[Rock](http://rock-robotics.org)
• Expectations on robots increase
  - More complex tasks
  - Complex missions
    - Different modes of operation / behaviors
  “Robot programming increasingly becomes a software integration and configuration task”
  → .. but it’s still complex
Robot Manipulation Behavior Generation

Contribution
Workflow for robot manipulation behavior design
- easy to work with
- supports transfer of behavior

- Utilization of specific algorithms
- Data processing for control
- eDSL to support development
Utilization of specific algorithms

- Parametric motion description “Motion Plan Driver”
  - Represent different motion by exchanging motion parameters
  - Adaptive to current situation
  - Tools for creating motion parameters
    - e.g. Imitation Learning

- Whole-body control algorithm
  - Impose constraints on parts of the robot
  - Allow parallel execution of controllers using same CPU
    - can spare a lot of developing work following a model-based development
    - concepts that automatically embeds those algorithms “correctly” within the component network
  - Construction of a graph containing geometric transformations
  - Allow querying the graph to provide specific transforms between arbitrary nodes within the graph

Data stream operations

- Allow splitting and merging data streams for specific data types

Kinematics

- Robot independent implementations of forward and inverse kinematics

The development workflow

1. Model
   - Build a pool of reusable items:
     - Create model parameters for motion models and object detection algorithms
     - Describe robot kinematics, and robot devices
     - Create virtual control interfaces

2. Combine
   - Describe robot behavior:
     - Build compounds of items from Model step
     - Extend processing chains

3. Concatenate
   - Arrange behaviors chronologically:
     - Extract patterns from data in component network
     - Chronological arrangement of behaviors

External, algorithms-
Specific tools

Not part of this work
Part of this work
Control Network Specification

• **Component model**
  - Orocos RTT
  - Configuration interface
  - Data flow interface
  - Life-cycle
  - Single-purpose

• **System modeling**
  - Data Service: Semantic labels ↔ abstract data flow interface
  - Compositions: Functional subnetworks of actual components, Data Services, already modeled subnetworks
  - Instantiation requirements: Selection of actual components for Data Services. Choosing of configurations for component.

• **Plan management**
  - Represent and execute plans ("missions")
  - Component network models can be used as tasks
    • Component network instantiation
    • Supervision
2.8 ‘A framework for describing manipulation behavior’ – Malte Wirkus

User code

```ruby
eds1_context do
  #block of ruby code
  #and context-specific
  #commands
end
```

```ruby
class MetaModel
  def context_command(arg)
    #configure MetaModel
  end
end
```

Hardware Resources

```ruby
module Devices
  joints_device_type "MyJointsPositionDriver" do
    position_controlled
  end
  joints_device_type "MyJointsVelocityDriver" do
    velocity_controlled
  end
end

MyJointDriver::Task.driver_for
  Devices::MyJointsPositionDriver, :as =>
    'position_controlled'

MyJointDriver::Task.driver_for
  Devices::MyJointsVelocityDriver, :as =>
    'velocity_controlled'
```

Base Components
- Kinematics
- Split/merge data streams
- Multi-purpose controllers
- Transformer
- Whole-Body Control

Component Network

Inject information in Instance requirements of compositions

Create configurations for base components
Robot

```plaintext
robot do
kinematic_description
"/path/to/my/kinematic_description.urdf"
device(Devices::JointsPositionDriver, ias =>
'arml').joint_names('ar', 'br', 'cr', with_conf('arms'))
device(Devices::JointsPositionDriver, ias =>
'armr').joint_names('ar', 'br', 'cr', with_conf('arms'))
device(Devices::JointsPositionDriver, ias =>
'el').joint_names('el', 'el', with_conf('arms'))
device(Devices::JointsPositionDriver, ias =>
'hi').joint_names('hi', 'hi').with_conf('hi')
device(Devices::JointsVelocityDriver, ias =>
'head').joint_names('p', 'l').with_conf('head')
end
```

Control Networks

```plaintext
control_collection "12" do
used_joints = ['ar', 'br', 'cr', 'wr', 'p', 't']

wbc_interface used_joints, ias => 'wbc',
initial_joint_weights => [1] * used_joints.size
  do
    cartesian_control_interface ['O', 'WR'],
      ias => 'cart_arm_plus_wrist',
      :joint_names => ['ar', 'br', 'cr', 'wr'],
      :priority => 1, :weights => [1, 1, 0.5]
    control_interface ['p', 't'], ias => 'head',
      :priority => 2
    control_interface ['ar', 'br', 'cr', 'wr'],
      ias => 'body_posture', :priority => 3
  end

control_interface ['gr'],
  :control_mode => :position,
  ias => 'finger'

cartesian_control_interface 'O', 'KL',
  :joint_names => ['sl', 'bl', 'cl', 'wl'],
  :control_mode => :velocity,
  ias => 'other_arm'
cascade_control_finger_interface do
  push TrajectoryGeneration::Task
    .with_conf('arm_with_hand')
cend
```

Extend control interfaces with control chains
2.8 ‘A framework for describing manipulation behavior’ – Malte Wirkus

1. Model
Build a pool of reusable items:
- Create model parameters for motion models and object detection algorithms
- Describe robot kinematics, and robot devices
- Create virtual control interfaces

2. Combine
Describe robot behavior:
- Build compounds of items from Model step
- Extend processing chains

3. Concatenate
Arrange behaviors chronologically:
- Extract patterns from data in component network
- Chronological arrangement of behaviors
Information required to describe an cartesian interaction

- Motion plan driver task
- Object structure representation (urdf)
- Object detector task
- Name of object pose reconstruction frame
- Name of object interaction frame
- Action-specific transform applied to interaction frame
- Sensor to use for detection
- Cartesian control interface
- Action specific transform applied to tip of control chain

![Diagram showing information required to describe an cartesian interaction]

Data processing for Cartesian control

- Decouples robot morphology from task motion and sensor processing
- Motion description can be applied to different context
Automatic transformation resolution and component interconnections

Callable “action”, that when executed, attaches a motion command generating component network to the “main” component network

Discussion
Summary

- Workflow for robot manipulation behavior design
  - Supports transfer of behavior between robots and application contexts
  - Allow specification of multi-stage control networks
  - Attach robot-independent task description
  - Support developers by providing domain-specific high-level commands and allows integration of additional tooling
Next steps

- Evaluation with
  - Control network
    - operational, safety layer and driver layer
    - containing joint devices with different control modes
  - Mission consists of different manipulation behaviors
2.9 ‘Rock Tutorials Recap’ (FW-T-09)

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Abstract

The presentation starts with a review on the workshops that were done at DFKI during the last year. The workshops focused on hands-on work with other rock users in following the tutorials. Next, a summary of the feedback received from the attenders will be presented. Finally, lessons learned and next steps towards helping new users learn rock efficiently can be discussed.
Project Day 19.03.2015
AG Framework
Rock Tutorials Recap
Raúl Domínguez

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2014 Rock Tutorials Workshops
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## 2014 Rock Tutorials Workshops

### Tutorials
- Installation
- Basics (8)
- 10 Presenters

### Feedback

**Average Previous Knowledge**
- C++: Intermediate
- Ruby: Beginner/Never Used
- Rock: Beginner/Never Used
- Git: Intermediate
- Linux: Intermediate
Feedback

Experience

- Taking part was for me worth
- Would recommend others
- Learned what I expected
- Useful for my work
- Clear exposition and structure
- Questions regarding difficulties
- Comments and discuss
- Work environment
- Overall rate
- Difficulty (Easy to Difficult)
- Provided Information (Few to Much)

Was Missing

- Rock Overview
  - Main Features
  - OROCOS, RTT . . .
  - Differences to ROS
- Overall Usage
  1. Grasp Workflow
  2. Coding and Building

Proposals

- Two Time Slots
- More Examples
- More Explanations
- Real Scenario Case Study
  - Involve More Components

March 18, 2015

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March 18, 2015

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## Conclusions

### Discussion
- Introductory Overview?
- Do *Just* What is on the Tutorials? Explain Further?
- A Real Use Case?
- Alternative Time Slots

### 2015 Rock Tutorials Workshop
- To be Announced
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