Thanks to our current maintainers!

Robert Haschke, CITEC, Bielefeld University
Michael Görner, University of Hamburg
Isaac IY Saito, Plus One Robotics
Ian McMahon, Toyota Research Institute
Gijs van der Hoorn, Delft Univ. of Tech / ROS-I
Jorge Nicho, SwRI / ROS-I
Bence Magyar, Heriot-Watt University
Mike Lautman, PickNik Robotics
Jon Binney, Iron Ox
Henning Kayser, PickNik Robotics
Bryce Willey, Realtime Robotics
Mark Moll, PickNik Robotics
Dave Coleman, PickNik Robotics
Thanks to our many contributors!

Original Team
Sachin Chitta  Kinema Systems
IoanSucan  Google X
Dave Hershburger  Kinema Systems
Acorn Pooley  SRI International

Core Contributors
Michael Ferguson  Independent Consultant
Zak Kingston  Rice University
Felix von Drigalski  OMRON SINIC X Corporation
Simon Schmeißer  isys vision
William Baker  Houston Mechatronics
Andy Zelenak  PickNik Robotics
Mohammad El khzragy  TUM
Kei Okada  JSK Lab, Univ of Tokyo
Martin Günther  DFKI
Shingo Kitagawa  JSK Lab, Univ of Tokyo
Yan Yu  Intel
Víctor Mayoral  Acutronic Robotics
Anas Mchichou  Acutronic Robotics
Levi Armstrong  SwRI / ROS-I
Organizing Committee for Movelt Workshop

Rob Coleman  Tahnee Foley  Dave Coleman
Schedule

- **9:00 Welcome**
  - Invited Talks
- **10:00 Coffee / Tea Break 1**
  - Invited Talks
- **12:30 Lunch**
  - Panel Discussion
  - Group Roadmapping
- **15:00 Coffee / Tea Break 2**
  - Hands on With Task Constructor
  - Lightning Rounds
- **17:00 End of Workshop**
Prep for later today

- If you have a lightning talk, please sign up and send us your PDF:
  - Sign Up: shorturl.at/dxDL9
  - Send Slides to: mike@picknik.ai

- For the optional hands-on section, pre-install MoveIt Melodic (18.04):
  ```
  sudo apt-get install ros-melodic-moveit
  git clone https://github.com/ubi-agni/moveit_task_constructor.git -b tutorial
  git clone https://github.com/ros-planning/panda_moveit_config.git -b melodic-devel
  ```
  See also https://moveit.ros.org/install/

- Wifi: Sheraton_Conference
  - CT9R4JQP
Previously At ROSCon 2019

- Introducing MoveIt Grasps, a manipulation framework
  - Mike Lautman
- Flexible Framework for Quantitative Reachability Analysis
  - Michael Ripperger
- Reactive Jogger for Teleoperation and Contact Tasks
  - Andy Zelenak, Robert G. Reid, Mitch Pryor
- cartesian_controllers: Motion, Force and Compliance Control for Robotic Manipulators
  - Stefan Scherzinger, Arne Rönnau
- OpenVINO™ Acceleration for Intelligent Robot
  - Sharron LIU, Yu YAN
- Safety Certified ROS-native Industrial Manipulator
  - Christian Henkel
Why a MoveIt Workshop?

An informal day of presentations, panel discussions, and hands-on training of latest MoveIt features.

The intended audience are primarily experienced and advanced users of MoveIt.
Movelt is 8 years old!

Stable version 1.0 released this year
An Open Letter to the Movelt! Community

Dave Coleman
8 Nov 2018

Dear Movelt Community,

I’m writing to make some changes to the direction of Movelt! - let’s shake things up, try new things, and be less conservative in making improvements. I’m doing this because I really care about the role of open source robotics in the years to come. I envision a future where everyone has access to the economic prosperity of robotic manipulators.

A few weeks ago I attended an open source conference where I led a discussion session I titled “Stability vs Growth: Breaking API”. I presented to the audience of diverse projects a problem I believe we’ve been struggling with in our ROS and Movelt! community: stagnation and irrelevance. After speaking with many attendees, I came away with the belief that our now 7 year old project is stuck, making only minor incremental progress since Willow Garage shuttered its doors in 2013. Meanwhile, the robotics world has raced forward.

There are many reasons I believe Movelt! is facing this innovator’s dilemma, and I want to outline some of them here with the public declaration that we at PickNik intend to change this, with your help. We see an exciting future for Movelt!, and we believe we can transform it from a stagnant open source project, to a globally recognized platform that enables organizations of all sizes to leverage robotics for their applications. Before I outline the solution, I want to clearly state some major parts of the problem:

Lack of Major Versions

Movelt! has not yet officially been declared 1.0, yet we maintainers typically take the stance that API
Key New Features In MoveIt Ecosystem

- **MoveIt Task Constructor**
  - Task Planning
  - Robert Haschke, Michael Görner
- **MoveIt Grasps**
  - Geometric-based grasp generation
  - Mike Lautman, Dave Coleman
- **MoveIt Cpp**
  - Advanced API for performance
  - Henning Kayser
- **MoveIt JogArm**
  - Realtime teleoperation planner
  - Andy Zelenak
- **CHOMP Planning Adapter**
  - Post-processing of OMPL-generated plans
  - Raghavender Sahdev
- **Iterative Cubic Spline Algorithm**
  - Smoother trajectory generation
  - Ken Anderson
- **Time-Optimal Trajectory Parameterization**
  - Follow path within bounds on accelerations & velocities
  - Michael Ferguson, Henning Kaiser
- **Named Frames on Collision Objects**
  - Subframes for placing objects
  - Felix von Drigalski
MoveIt Task Constructor
MoveIt Grasps
MoveIt Cpp Interface
MoveIt JogArm
Named Frames on Collision Objects
Time Parameterization

- Iterative Cubic Spline Algorithm
  - Smoother trajectory generation
  - Ken Anderson

- Time-Optimal Trajectory Parameterization
  - Follow path within bounds on accelerations & velocities
  - Michael Ferguson, Henning Kaiser
Optimizations Based On Levi's Work

- **TrajOpt**
  - Optimization-based motion planner
  - Levi Armstrong, Omid Heidari
- **Bullet Collision Checker**
  - Alternative motion planner
  - Jens Petit
- **Unified Collision Environment for Speedup**
  - Combine robot and environment into one scene
  - Jens Petit
- **Speedups with Eigen::Isometry3d**
  - Faster linear algebra operations
Other Improvements

- **Faster Inverse Kinematics Solvers**
  - Robert Haschke

- **Windows Support**
  - Special build rules from Microsoft

- **New Inverse Kinematic Solvers**
  - KDL, IKFast, LMA

- **Easier Quick Start in the Setup Assistant**
  - Setup for Gazebo and ros_control

- **Better Benchmarking Suite**
  - Improved statistics, comparisons, simplification

- **Improved quality of Cartesian paths**
  - Jump threshold

- **FCL shape cache thread-local for speedup**
  - Faster collision checking

- **Improved Rviz motion planning plugin**
  - Better user interfaces

- **Constraint approximation databases**
  - Speedup planning in difficult regions

- **Realtime Robotics RapidPlan Integration**
  - Plugin for FPGA-based collision checking
# A Feature-Rich Ecosystem

## Global Planners
- OMPL
- SBPL

## Local Planners
- CHOMP
- STOMP
- TrajOpt

## Cartesian Planners
- RobotState
- Descartes
- JogArm
- PilzIndustrial Motion

## Inverse Kinematic Solvers
- KDL
- IKFast
- TrackIK
- LMA
- BioIK

## Grasping Libraries
- MoveIt Grasps
- Grasp Pose Detection (GPD)
- Intel OpenVino

## Collision Checking
- Fast Collision Library (FCL)
- Bullet

## Perception / Octomap
- Depth Images
- Point Clouds
Documentation!

Getting Started
MoveIt Quickstart in RViz
Move Group C++ Interface
Move Group Python Interface
MoveIt Commander Scripting
Robot Model and Robot State
Planning Scene
Planning Scene ROS API
Motion Planning API
Motion Planning Pipeline
Creating Moveit Plugins
Visualizing Collisions
Time Parameterization
Planning with Approximated Constraint Manifolds
Pick and Place
MoveIt Grasps
MoveIt Task Constructor
Subframes

MoveIt Setup Assistant
URDF and SRDF
Low Level Controllers
Perception Pipeline Tutorial
IKFast Kinematics Solver
TRAC-IK Kinematics Solver
Kinematics Configuration
Custom Constraint Samplers
OMPL Planner
CHOMP Planner
STOMP Planner
TrajOpt Planner
Planning Adapter Tutorials
Joystick Control Teleoperation
Arm Jogging in Real-Time
Benchmarking
Integration/Unit Tests
This is the latest version, which is actively developed. For beginners, we recommend the stable Melodic tutorials. If you are still running a Kinetic release, please use the Kinetic tutorials.

MoveIt Tutorials

These tutorials will quickly get you, and your robot, using the MoveIt Motion Planning Framework.
Moving robots into the future

Easy-to-use robotics manipulation platform for developing applications, evaluating designs, and building integrated products.

WATCH OUR MONTAGE  GET STARTED

Latest: Melodic / Ubuntu 18.04
Install from Debian
Version: 1.0.0
Install from Source  View on Github

ROS
A Hardened Motion Planning Platform
Timeline

- **2008**: First commit of OMPL
- **2009**: PR2 autonomously opens doors and plugs in power outlets
- **2010**: Arm Navigation package released
- **2011**: Fast Collision Checking Library (FCL) Announced
- **2012**: Willow Garage Closes
- **2013**: SRI supports MoveIt
- **2014**: MoveIt Beta Announced
- **2015**: MoveIt Ranked #3 ROS Package
- **2016**: First Movelt Community Meeting
- **2017**: First World Movelt Day
- **2018**: 3 GSoC Movelt Students
- **2019**: New tutorials and website

**Movelt Initiated**

**Movelt Beta Announced**

**Movelt Single Repo Merge**

**Movelt 2.0 Alpha**

**Movelt 1.0**

- **2008**: PickNik LLC Formed to Support MoveIt
- **2018**: PickNik hires first 3 people

**2008 - 2018**

**2019**

**Timeline**

**Timeline**
<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>152</td>
<td>Robots integrated to work with MoveIt</td>
</tr>
<tr>
<td>23,662</td>
<td>Downloads per month of moveit_core</td>
</tr>
<tr>
<td>542</td>
<td>Academic citations of MoveIt</td>
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<tr>
<td>109,880</td>
<td>Unique users to moveit.ros.org in 2019</td>
</tr>
<tr>
<td>4200</td>
<td>Members of Discourse, MoveIt's Discussion Forum</td>
</tr>
<tr>
<td>482</td>
<td>Github users have starred the MoveIt project</td>
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<tr>
<td>177</td>
<td>Github code contributors to MoveIt</td>
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<tr>
<td>13</td>
<td>International locations participated in World MoveIt Day 2018</td>
</tr>
<tr>
<td>310</td>
<td>In-person participants of World MoveIt Day 2018</td>
</tr>
</tbody>
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