



The European Coordination Hub for Open Robotics Development



4th Review Meeting – WP3

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MOdular **D**rive **U**nits for **LE**gged locomotion

Luxembourg – 2018-02-21

Background

Motivation for the Work Conducted

- Build a fully integrated, robust, force controllable series elastic actuator module. Integrate this robot joint in a quadrupedal walking robot.

Technical Problem Addressed / Challenge Overcome

- Integrated joint unit with motor, gear, spring, load bearings, electronics and controls – position-, velocity- and force-controllable.
- Minimal size and weight, IP 67

Expertise Relied on

- Long history of design and robot application expertise at ETH Zürich
- Sophisticated motor control electronics expertise in CCD

Start-date / End-date: January 2015 – June 2016

Participation in Experiment Booster?

- YES, to bring ANYdrive from TRL 7 to TRL 8



ANYdrive



ANYmal



ANYpulator

Solution Developed

Starting Point

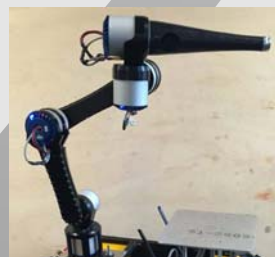
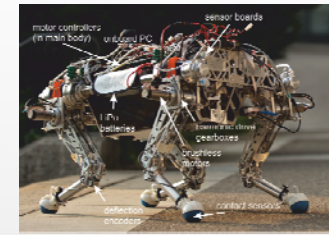
- ALoF and StarLETH were initial quadrupeds built at ETH
→ clear need for an integrated Serial Elastic Actuator

Approach Followed / Development Work Conducted

- ANYdrive was developed as a single module with tightly integrated motors, gears, springs, electronics and controls.
- Application tests were performed with the newly developed ANYmal quadruped robot

Technical Result / End Point

- TRL 7 prototype for ANYdrive developed
- Hardware and software tested operationally in various competitions.



Being an Experiment in ECHORD++

Benefit from participation in ECHORD++

Impact on Development Process

- Combination of design and robot locomotion expertise at ETHZ with motor control expertise at CCD
- Unique opportunity to make a step beyond pure research to develop a market ready prototype device
- ECHORD++ helped bridging the gap between basic research at ETH and commercial product at ANYbotics
- Helpful ECHORD++ support for technical fairs to build supplier & customer network

Actionable Insights

- Build the base for a commercial product ANYdrive to be completed in ECHORD++ Booster MODU78 project
- Core component developed to enable high performance locomotion
- Prerequisite for a high performing **ANYmal** platform and a successful startup company **ANYbotics**

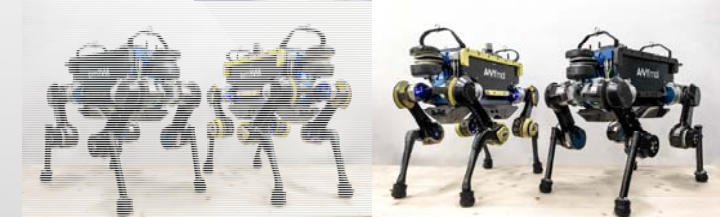


ANYbotics

Impact of Work Conducted

What do you have to show for it?

- >80 prototypes sold to academia and industry
- 5 ANYmal prototypes (=60 ANYdrives!) built and sold
- MODU78 covers step from TRL7 to TRL8 in 2018
- ANYdrive commercial launch planned 2nd half 2018



What has the support allowed you to achieve

- Increase in technology maturity, to develop a TRL7 product
- This project was a pre-condition for commercialization of both ANYdrive and ANYmal
- Start-up founded in 09.2016, 17 people today, >2 MEUR sales, 2.5 MEUR project financing



How does the outcome fit with your development strategy

- Perfectly!



Outlook

Next steps

- Product commercialization and industrialization, qualification/certification to the extent needed
- Actively develop the business, new applications

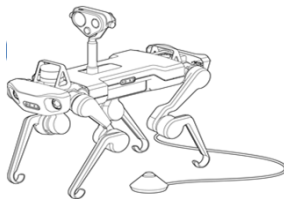


Longer term perspectives and growth expectations

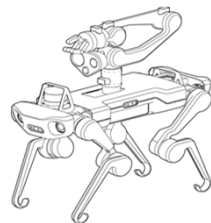
- **Business plan 2020:**
 >30 employees
 > 10 MEUR sales
 breakeven



Inspection



Manipulation



Collaboration

