

# V-REP Integrated Paparazzi Simulation

November 29, 2018



# Overview

Introduction and Motivation

Architecture

Problems

Evaluation

## Project goals

- ▶ Creation of a simulation environment for the SwarmLab copters
- ▶ Use existing Paparazzi infrastructure
- ▶ Should be easy to use and extend

## Why do we even need a Simulation?

- ▶ TODO: insert picture of broken copter part
- ▶ Simulation allows experiments without risking potentially expensive hardware
- ▶ Exploration of a wide range of potential environments and conditions
- ▶ Scalability

## Project idea

- ▶ Idea: V-REP plugin providing communication between Paparazzi and V-REP
- ▶ V-REP provides the copter state, Paparazzi the corresponding commands
- ▶ Main advantage: same code and infrastructure usable on simulated and real copters

## Why a new framework?

- ▶ There are other simulators for Paparazzi
- ▶ None of them provide all needed functionality/convenience

JSBSim	Gazebo	ARGoS
no swarm capability	no GUI	only 2D

## Base Architecture

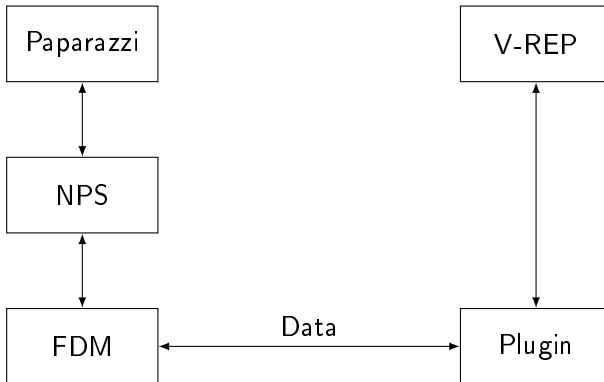
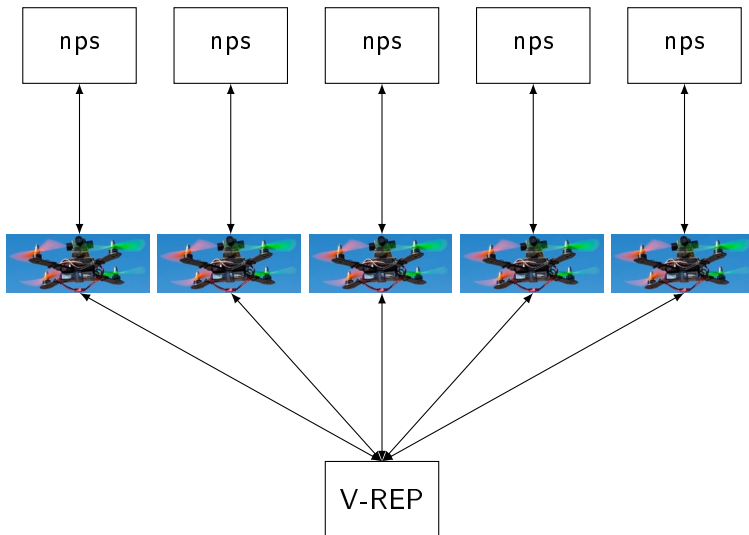


Figure 1: Basic simulation architecture

## Connection Architecture





## Loop overview

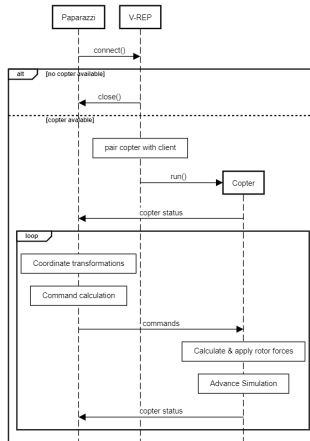


Figure 2: Simulation sequence overview

## Exchanged data: V-REP

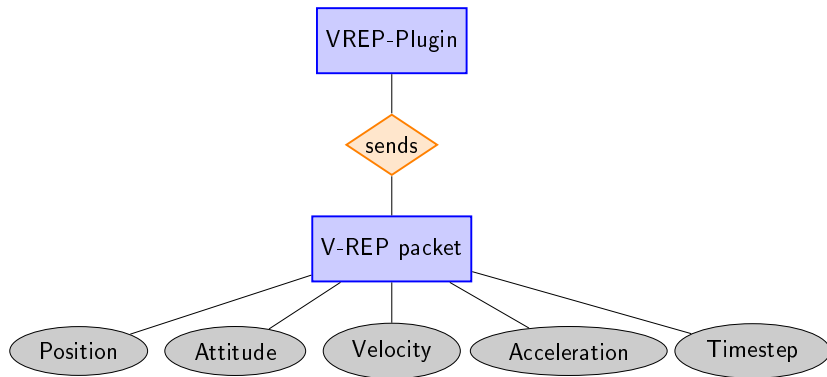


Figure 3: Data sent by V-REP to Paparazzi

## Exchanged data: Paparazzi

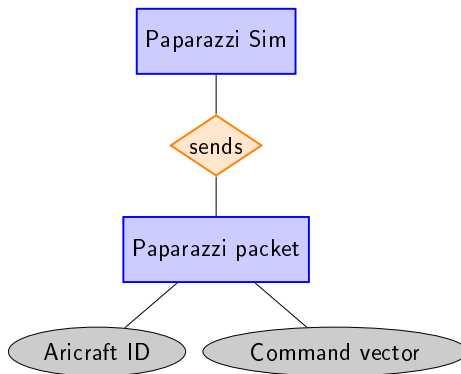


Figure 4: Data sent by Paparazzi to V-REP

# Problems

- ▶ Coordinate transformations
- ▶ Connection stability

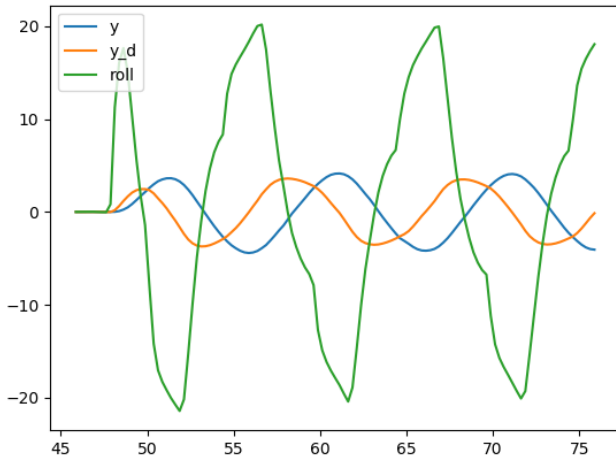
## Coordinate transformations

- ▶ Paparazzi provides most functions for coordinates transformations
- ▶ But: 90 degree offset in the attitude quaternion
- ▶ Also: Rotation and acceleration values for x and y axes were switched
- ▶ → multiple interdependent sources of errors, difficult to debug

## Connection stability

- ▶ Connection failure should not crash the entire simulation
- ▶ Correctly track connected and unconnected copters
- ▶ "Ghost Copters" lead to crashes

## Evaluation: Simple flight plan



## Statistics as well?

- ▶ insert statistic evaluation table



# Demo

# Thanks for your attention

- Special thanks: Christoph for always helpful advice and bug-hunting expertise

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