
R-VIO

R-VIO is an efficient, lightweight, **robocentric** visual-inertial navigation algorithm for consistent 3D motion tracking using only a monocular camera and a single IMU. Different from the standard world-centric algorithms which directly estimate absolute motion of the mobile platform with respect to a fixed, gravity-aligned, global frame of reference, R-VIO i) estimates relative motion of higher accuracy with respect to a moving, local frame (the IMU frame here), and ii) incrementally updates global pose (orientation and position) through a composition step. This code implements our robocentric sliding-window filtering-based VIO formulation that was originally proposed in our *IROS2018* paper and presented in detail in our recent *IJRR* paper:

- Zheng Huai and Guoquan Huang, **Robocentric visual-inertial odometry**, *The International Journal of Robotics Research (IJRR)*, 2022: download.

```
1 @article{huai2022robocentric,  
2   title={Robocentric visual-inertial odometry},  
3   author={Huai, Zheng and Huang, Guoquan},  
4   journal={The International Journal of Robotics Research},  
5   volume={41},  
6   number={7},  
7   pages={667--689},  
8   year={2022},  
9   publisher={SAGE Publications Sage UK: London, England}  
10 }
```

- Zheng Huai and Guoquan Huang, **Robocentric visual-inertial odometry**, *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Madrid, Spain, Oct 1-5, 2018: download.

```
1 @inproceedings{huai2018robocentric,  
2   title = {Robocentric visual-inertial odometry},  
3   author = {Huai, Zheng and Huang, Guoquan},  
4   booktitle = {IEEE/RSJ International Conference on Intelligent Robots  
5     and Systems (IROS)},  
6   pages = {6319--6326},  
7   year = {2018},  
8   address = {Madrid, Spain}  
9 }
```

This work has been further extended in our *IEEE RA-L* paper below, and the proposed R-VIO2 is also open sourced. - Zheng Huai and Guoquan Huang, **Square-Root Robocentric Visual-Inertial Odometry with Online Spatiotemporal Calibration**, *IEEE Robotics and Automation Letters (RA-L)*, 2022: download.

```
1 @article{huai2022square,
```

```
2   title={Square-root robocentric visual-inertial odometry with online
    spatiotemporal calibration},
3   author={Huai, Zheng and Huang, Guoquan},
4   journal={IEEE Robotics and Automation Letters},
5   volume={7},
6   number={4},
7   pages={9961--9968},
8   year={2022},
9   publisher={IEEE}
10 }
```

Robocentric Visual-Inertial Odometry

Zheng Huai and Guoquan Huang

Department of Mechanical Engineering
University of Delaware, USA

IROS video (**EuRoC MAV** dataset): YouTube.

University of Delaware Urban Driving Dataset

Camera @ 15Hz
IMU @ 400Hz
Length: 9.8km
Duration: 15min

IJRR video (9.8km **Urban Driving** test): YouTube.

1. Prerequisites

We have tested this code under Ubuntu **16.04** and ROS **Kinetic**.

ROS

Download and install instructions can be found at: <http://wiki.ros.org/kinetic/Installation/Ubuntu>.

Additional ROS packages needed: `tf`, `sensor_msgs`, `geometry_msgs`, `nav_msgs`, `cv_bridge`, `eigen_conversions`.

Eigen

Download and install instructions can be found at: <http://eigen.tuxfamily.org>. **Required at least 3.1.0.**

OpenCV

Download and install instructions can be found at: <http://opencv.org>. **Required at least 2.4.3. Tested with 2.4.11 and 3.3.1.**

2. Build and Run

First, `git clone` the repository and `catkin_make` it. Then, to run `rvio` with single camera/IMU inputs from the ROS topics `/camera/image_raw` and `/imu`, a config file in `config` folder and the corresponding launch file in `launch` folder (for example, `rvio_euroc.yaml` and `euroc.launch` are for EuRoC dataset) are needed, and to visualize the outputs of R-VIO please use `rviz` with the settings file `rvio_rviz.rviz` in `config` folder. `Terminal 1: roscore` `Terminal 2: rviz` (AND OPEN `rvio_rviz.rviz` IN THE CONFIG FOLDER) `Terminal 3: roslaunch rvio euroc.launch` `Terminal 4: rosbag play --pause V1_01_easy.bag /cam0/image_raw:=/camera/image_raw /imu0:=/imu`

Note that when testing the `Machine Hall` sequences, you should skip the data in the first few seconds (e.g., 40s for `MH_01_easy`) which are used for initializing the map for SLAM-based algorithms.

You can also run R-VIO with your own sensors (data) by creating a config file `rvio_NAME_OF_YOUR_DATA.yaml` in `config` folder and the corresponding launch file `NAME_OF_YOUR_DATA.launch` in `launch` folder, referring to our EuRoC example.

3. License

This code is released under GNU General Public License v3 (GPL-3.0).