**Steps for Collecting Data from a Multi-Robot Set-up**

The SwarmRobots have been configured with a complete platform for both controlling and collecting data from the various on-board sensors and software. While there are many ways of running the robot’s programs, the optimal set-up is through the ROS binary for Procman. Procman is a platform for managing many programs on several computers at once, which can be used to control each function and sensor of the SwarmBots.

This write-up is designed with a master computer and one or more swarm robots in mind, however, it can be modified depending on the situation. From configuring the master-agent relationships between the robots, to replaying a ROSBag to visualize the collected data, these steps go through the full set-up process.

1. The master computer and agent robot networks must be configured properly in the bashrc file before any other software is downloaded.
   1. sudo nano ~/.bashrc
   2. ctrl-end
   3. Verify “export ROS\_IP=<insert IP address here> matches” the computer’s IP address under wlp0 when running ifconfig
   4. Change export ROS\_MASTER\_URI=http://<insert IP address here>:11311 to the IP address of the master computer
2. Download Procman-ROS on each of the robots and the master computer.
   1. Procman-ROS depends on LCM, python2, and PyGTK
      1. LCM can be built from source through this [link](https://lcm-proj.github.io/build_instructions.html)
      2. sudo apt install python-minimal
      3. sudo apt install python-gtk2
   2. cd ~/catkin\_ws/src
   3. git clone <https://github.com/ashuang/procman.git>
   4. cd procman\_ros
   5. mkdir build && cd build
   6. cmake ..
   7. make -j4
   8. sudo make install
3. Assuming that the required software for each device is installed and built, and each robot’s devices are connected, Procman-ROS can be fired up.
   1. On each robot, attach a monitor + keyboard + mouse (preferably Bluetooth for ease of access)
   2. For each robot agent, type in “rosrun procman\_ros deputy”
   3. cd ~/catkin\_ws/src/procman\_ros/test (where the Procman-ROS launch file script should be written
   4. For the master computer, type in “rosrun procman\_ros sheriff swarm\_manager\_3robot.cfg” as well as “rosrun procman\_ros deputy”
      1. If the master computer is running anaconda, run “conda deactivate” to avoid python conflicts
4. With Procman-ROS configured on each respective robot and the master robot, data collection can begin with several commands.
   1. Each robot should be visible in the Procman-ROS GUI up on the master robot
      1. Start all processes/devices required for data collection
      2. In a separate terminal, record a rosbag
         1. The information recorded in the rosbag can either be all published topics with “‘-a” or the specific topics listed after “rosbag record”
            1. Examples of recorded topics: rtabmap/odom, <robot name>/laser, <robot name>/uwb, tf, tf\_static, camera/compressed etc
         2. The rosbag will save to whichever location the command is run in
      3. If RTABMap isn’t running through the Procman-ROS GUI, ssh into the robot’s terminal and start RTABMap from there. This output will still be recorded through rosbag record
5. Once a satisfactory dataset has been recorded, its output can be analyzed with Rviz.
   1. Play back the recorded rosbag, to simulate real-time data collection, with rosbag play <name of recorded rosbag>
   2. Simultaneously, launch rviz
   3. Add in all topics to be visualized through the broadcasted topics option
   4. Repeat steps as needed to go through different subsets of data from the robot’s collected information