

CHAPTER IV. GENERAL SIMULATION PROCEDURE

The general simulation procedure developed by the author is described as follows:

IV.A. Develop an installation procedure

An installation procedure was developed. This established a reproducible simulation environment and baseline for any changes. Development of the installation procedure is documented by Appendix A. The installation procedure is documented by Appendix B.

IV.B. Verify the installation procedure

The installation procedure was then verified. This ensured the simulation environment was reproducible. Verification of the installation procedure is documented by Appendix C.

IV.C. Verify Player and Gazebo using packaged world files, configuration files, and models

After developing the installation procedure in accordance with Appendix A, and verifying the installation procedure in accordance with Appendix C, the author attempted to verify the expected operation of Player and Gazebo using the packaged world files, configuration files, and models. Because the potential simulation targets required the author to implement a simulation of a challenge vehicle, the author first attempted to modify and use the packaged “simplecar” model. The author was unable to verify the expected operation of Gazebo due to several errors in the Gazebo source code, world files, and models. For various reasons, Gazebo would fail to load included world files, Player would not connect to Gazebo, and the `playerv` utility would not move the

model. At one point while attempting to verify the expected operation of Gazebo, the use of Stage in lieu of Gazebo was evaluated because of problems encountered. The author concluded the use of Stage, which provides a “2.5-D” simulation environment, would not provide enough realism for simulation of a challenge vehicle.

The author spent several weeks modifying Gazebo world files and Player configuration files and reviewing source code to determine the cause of the problems encountered. While reviewing the code to determine the cause of the problems encountered, the author noted that the Gazebo code base is being actively developed, and that, for reasons unknown, some changes “break” Gazebo in unexpected ways, and that some revisions of the Gazebo source code include extensive debugging information.

Problems encountered by the author while attempting to verify Player and Gazebo using packaged world files, configuration files, and models are documented by Appendix G.

IV.D. Upgrade Player and Gazebo

Review of mailing list archives and resolutions to similar problems encountered by other users suggested by Gazebo's developers indicates that “upgrade to the latest svn version” is the general response given when bugs are encountered and ostensibly resolved. Therefore, while troubleshooting the errors encountered while attempting to verify Player and Gazebo using packaged world files, configuration files, and models, later versions of Player and Gazebo were downloaded and installed.

The author downloaded the source distribution of Player 3.0.1 (“`player-3.0.1.tar.gz`”) from the Player Project ([38]), un-installed Player version 3.0.0 in

accordance with Appendix C, and installed Player version 3.0.1 in accordance with Appendix B.

The author uninstalled Gazebo version 8443 as described below, downloaded the latest revision (revision 8533) of the Gazebo 0.9.0 source code using the `svn` utility, and installed Gazebo revision 8533 in accordance with Appendix B.

As discussed in Appendix C, the author was unable to make `uninstall` or `make clean` Gazebo. As a result, when verifying the installation procedure the existing installation of Gazebo was archived by renaming the containing directory and manually deleting file `.gazebo.rc`. While researching the `cmake` utility, the author noted the `xargs` utility may be used to remove all files installed using the `cmake` utility ([39]) as follows:

```
xargs rm < install_manifest.txt
```

File `install_manifest.txt` provides a list of all files generated by the `cmake` utility during installation. This command was used to uninstall Gazebo.

When upgrading to Gazebo revision 8533, the author noted it was no longer necessary to modify file `audio.cc` in accordance with step “Install Gazebo” of Appendix B. File `audio.cc` had been revised to correct the error noted by the author.

IV.E. Configure the simulation for the selected simulation targets

After verifying Player and Gazebo using packaged world files, configuration files, and models and upgrading Gazebo, the simulation was configured for each selected simulation target. The author selected the following simulation targets:

- Simulation target 1: Use Player and Gazebo to evaluate the rollover of a

representative challenge vehicle entering 2004 GCE course segment 2570-2571-2572.

- Simulation target 2: Use Player and Gazebo to evaluate the use of LIDAR, in particular the quality of the point map created by SICK LMS 200 and 291 LIDAR sensors, and increase in the number of SICK LMS 291 LIDAR sensors.
- Simulation target 3: Use Player and Gazebo to evaluate field-of-view limitations for selected sensors, specifically navigation RADAR.

Due to time constraints, and the difficulty “fitting” a braking profile to a simulated challenge vehicle, the author decided not to implement a two-material friction model.

Due to time constraints, the author decided not to modify Player and Gazebo to simulate sensor noise.