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Calibration and Testing

Starting the Robots

When the field has been build up, turn on the router. When the router is starting up, put the batteries into the robots and turn on the robots by flipping the black power switch located on the back. Once you hear the famous 'click' it means the TURTLE is fully booted and the software is started.

In the meantime, the router should have started, on the laptop, in a terminal (CTRL+ALT+T), type

```
robocup@devpcX:~$ robocup_network
```

- To check if you can communicate to the TURTLE, execute in a terminal (where Y should be replaced with the number of the TURTLE):

```
robocup@devpcX:~$ ping turtleY
```

- If not succesful try running `robocup_network` again and check if the router is powered on.

Copying Software

- The software can copied to the robot using Matlab, to start Matlab type in the terminal:

```
robocup@devpcX:~$ sudo su
root@devpcX:/home/robocup# matlab
```

(the first command makes you a super-user (system-admin), the second starts Matlab.

- To copy the demo software run the following in Matlab:

```
>> copy_demo turtleX
```

where X represents the numbers of the turtles you want to copy the software to. To copy to multiple turtles at once, simply type all the numbers (turtle123456).

- A window pops up to ask which field you are going to give a demo on. This decides the size of the field; only if the demo is given at Tech United RoboCup stadium select "TU/e field", if you use the field consisting of tiles, select "Demo field"
- Check if the copying went succesful (*copy com successo*). If not, make sure the TURTLE is powered on and you are connected to the `robocup_network`.

Prepare Calibration

- To calibrate the robots, execute in Matlab

```
>> calibration_gui
```

General Idea

In the Figure below you can find the calibration user interface for the TURTLES, this is the place where you control the calibration of the TURTLE's sensors and the TURTLE itself. The calibration data consists of 5 parts:

- Ball: this defines what colors make up "the color of the ball", these colors (and therefore the calibration) are sensitive to changes in light conditions,
- Compass: this defines the heading of the TURTLE when facing the blue goal,
- Mirror: this calibration is needed to define how the Omni-vision mirror is positioned with respect to the camera, this calibration only has to be done when it is expected that the camera and/or the mirror have shifted slightly,
- Mask (& Heading): this defines the parts of the TURTLE which it detects in its own Omnivision image, this is sensitivite to slight shifts in the camera and/or the mirror position.

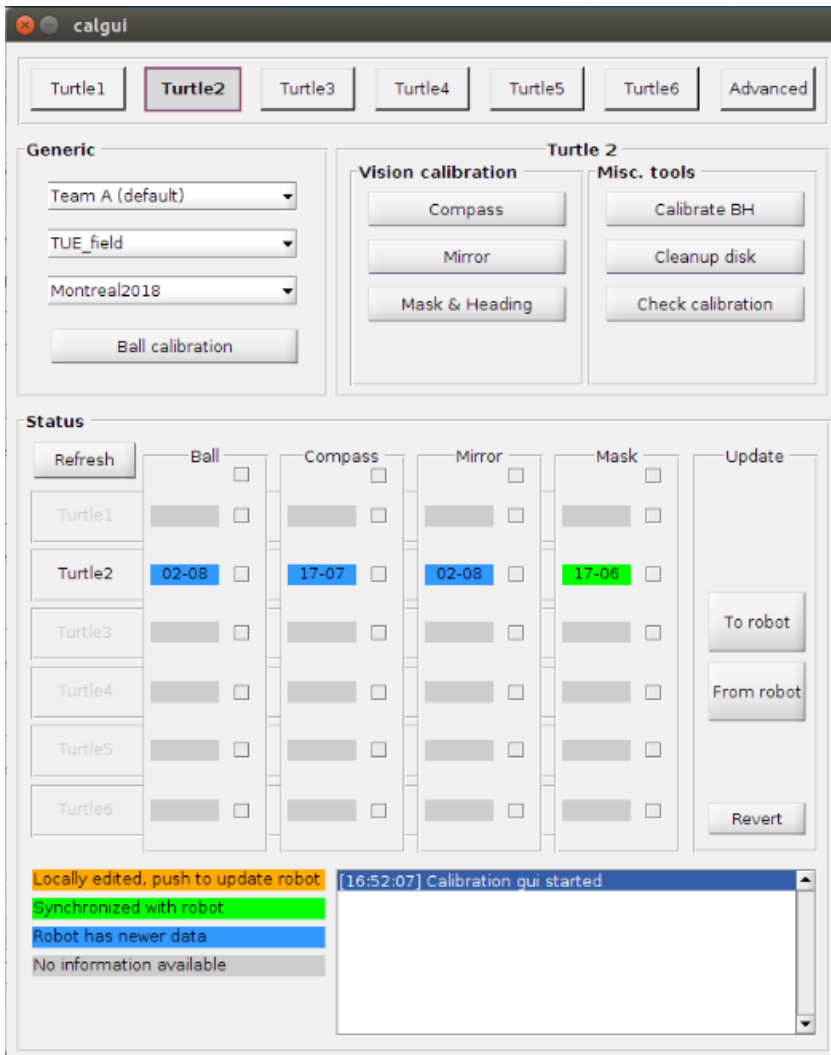
For these four parts (number 5 will follow, don't worry) you see in the central part of the GUI the status of the calibration, as explained in the bottom left corner, the data you have on this DevPC can be:

- locally edited: you have changed this data but the TURTLE did not receive it yet,
- synchronized: you have the same data as the TURTLE has,
- robot has newer: the calibration on your DevPC is older than the calibration which is currently on the TURTLE.

To change the state, use the buttons *To robot* and *From robot*. For example, when the robot has newer data, a push on *From robot* will move the data from the robot to your DevPC changing the status (sometimes after refreshing) to synchronized. Another example, suppose the status is *locally edited* a *To robot* will move your new calibration to the robot, a *From robot* will overwrite the newly created calibration on your DevPC with the (potentially) older calibration data on the robot.

Then there is one part of calibration data left: the ball handling, this data is automatically send to the robot, so this can be done using *Calibrate BH* in the top right corner.

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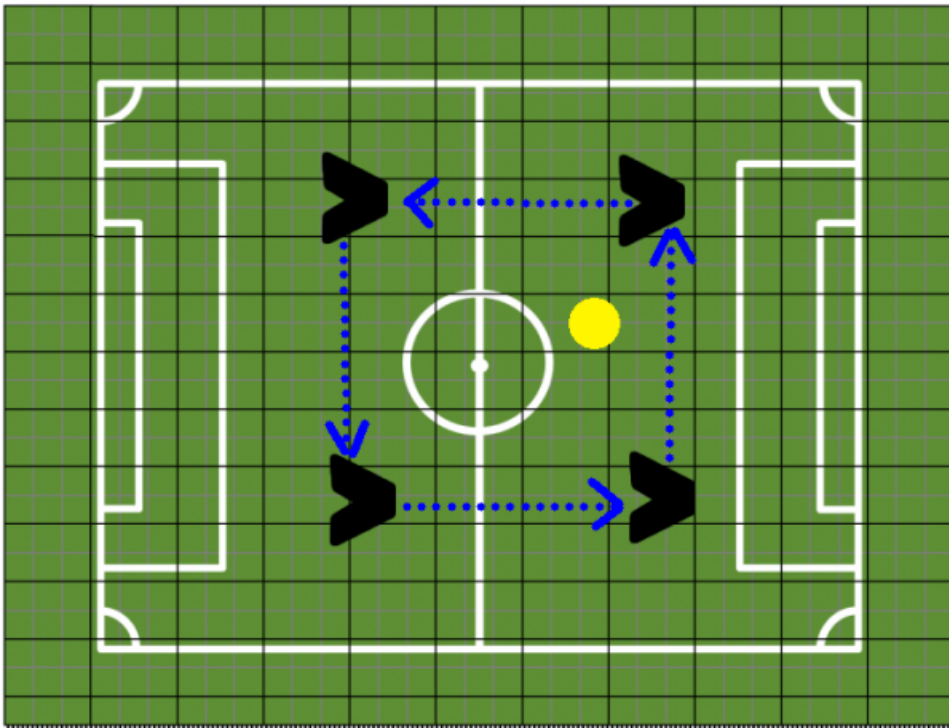


Procedure

- **Important:** make sure you've selected TUE_field or Demo_Field, in the *Generic*-part top-left of the GUI (after changing, wait a little, software is reconfiguring)
- The steps below have to be executed for all TURTLES which are present at the demo. We will now calibrate the robots one-by-one (except for **Compass Calibration!**). So after calibrating one robot, come back **here**.
- Change the number of the TURTLE you are calibrating by clicking (at the top of the GUI) the upcoming TURTLE number which you are going to calibrate.
- If the demo is at the TU/e field, you can skip the **Mirror Calibration** and **Compass Calibration** (below), you can skip to the **Ball Calibration!** We always skip the **Mask & Heading Calibration!**

Mirror Calibration

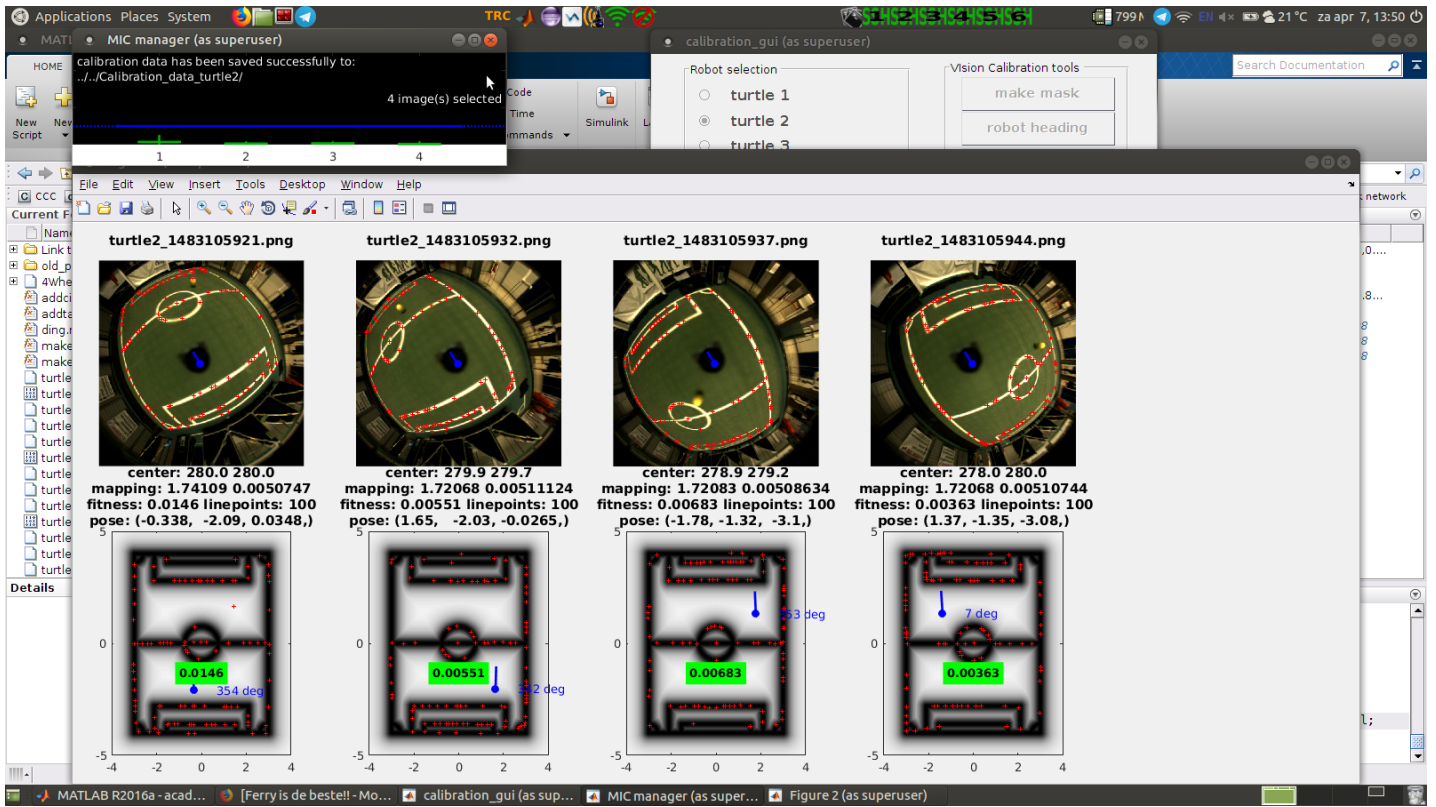
- Place the TURTLES distributed on the field as shown in the Figure, these TURTLES are ALL oriented towards the opponent goal (the big penalty goal). Make sure there is are a couple of balls on the field.



- Then, on the DevPC execute in a terminal:

```
robocup@devpcX:~$ sudo su
root@devpcX:/home/robocup# trc
```

- At the top of the TRC, select all the TURTLEs in the trc that are on the field.
- Make sure the software on the TURTLE is running. The software is running if you see green lights appearing. If this is not the case, push the green checkmark, to start the software. Switch the role of all TURTLEs from "Inactive" to "ROLE_NONE".
- Click on 'Manual' which pops up a new window. Click now for all active TURTLEs on Get photo and compass data, and wait everytime for the photo to appear before proceeding.
- Then switch the positions of the robots, make the photos and switch, until you have four photos for every active robot. Make sure the robots are facing the same direction all the time.
- Do this for every TURTLE and on different positions on the field so that each TURTLE shot about 4 photos each. Preferably change the TURTLE's positions as indicated in Figure 5 by the blue path, but keep the TURTLEs facing the same direction all the time!
- If all the photos are made, go back to the Calibration GUI (make sure the Field selection is set to the right field!)
- In the Calibration GUI, click on "Mirror", select all the photos you just made (modified date can help here) with shift+click and open them. Wait for the MIC manager to complete. It tries to detect white lines and places red dots on them. Then it tries to fit a soccer field to the points.
- The fitness value determines how well the fitting went. An ideal value is lower than 0.02. When all pictures are treated click on the blue "Validate" button. The MIC Manager now tries to determine the TURTLEs pose on each picture. The number on the binary image becomes green if this went succesful. A succesful should look something like below



- When asked to save this calibration, choose "Yes"! Close the MIC manager and the figure with the photos.

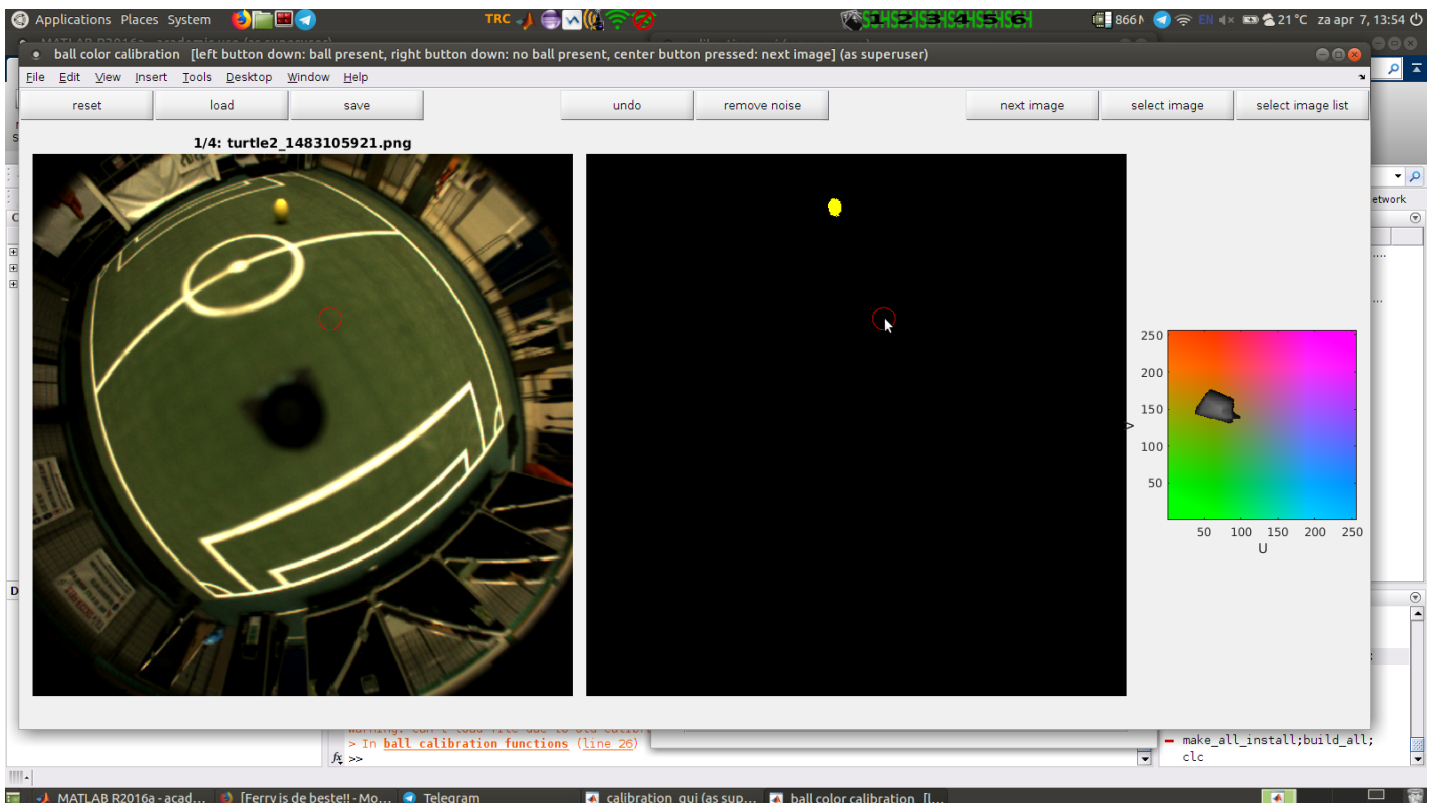
Compass Calibration

!! Note, the Compass Calibration can be done for all TURTLE's at once!!

- Click on **Compass** in the Calibration GUI and, when all TURTLE's are facing the same direction, click the buttons to calibrate the compass. After clicking the buttons of all the TURTLE's present, close the Compass Calibration-window.

Ball Calibration

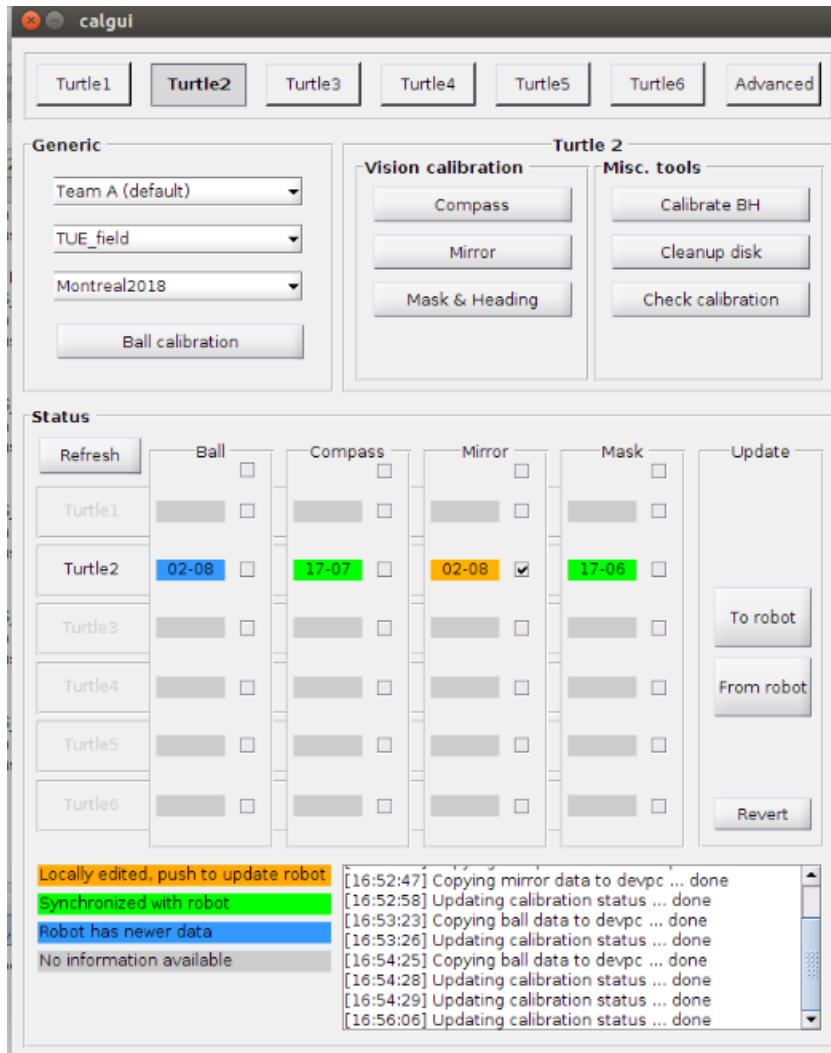
- Click on the button "Ball Calibration". Select all the photos from the open file dialog with a shift+click.
- On an image, left click on the ball and right click on false positives.
- Make sure only the ball is highlighted in yellow and other stuff is not. In case some separate yellow pixels are in the image click "Remove Noise". In case large clusters of yellow pixels exist (not on the ball) use the right-mouse button to remove them. Make sure the lines and the lights on other robots are not highlighted.
- When satisfied click on "Save Calibration", click on "Main Ball" and then select the TURTLE.



Copy Calibration to TURTLE

- If all steps above went successful you are now done calibrating this TURTLE. The status of the (Compass-, Mirror-, and) Ball-calibration should have changed to *locally edited*, tick the boxes of calibration data you would like to send and push *To robot*.

In the Figure below is an example, we have just calibrated the Mirror of Turtle2, the calibration shows up as *locally edited*. We also have already ticked the box of the Mirror-calibration data of Turtle 2, such that, when we push *To robot*, the data will be send to the robot. Attention: when you accidentally push *From robot*, your newly created calibration data is overwritten by the data on the Turtle; meaning you have to start over!



Ball Handling Calibration

- At the top right side of the calibration_gui, click on "BH Calibration". A windows pops up that tells you to push the ball in the ballhandling mechanism.
- Walk to the TURTLE selected. Push the ball into the ballhandling, don't use too much force, wait for 2 seconds you should hear the TURTLE make a "click" sound and the pop-up on your screen disappeared.
- This calibration is automatically copied to the TURTLE.

Testing

Now that the TURTLES have the correct software and calibration we are ready to start testing. Remember to keep the emergency switch with you at all times!

- In a new terminal execute the following to start the trc ("T"urtle "R"emote "C"ontrol):

```
robocup@devpcX:~$ sudo su
root@devpcX:/home/robocup# trc
```

- Click on the TURTLES you want to control and click on the green checkmark to start the software on each TURTLE.
- Test for example the ballhandling demo, a free kick and possibly a 2 vs 2 match. For more information on how the TRC is used during demo's, see the document [How to use the TRC during a demonstration](#)


Appendix A: recalibration Emergency Remote Control


In case you have to recalibrate the Emergency Remote Control, follow these steps:

- remove the TURTLE cover, on the right side, below the antenna you'll find a PCB belonging to the emergency-button
- push the small, brown colored, button on this PCB once, a red led will be visible
- push the button on the emergency remote control once, the led on the PCB should turn of now

4. push the button on the emergency remote control again, the red led will start blinking. Keep pushing the button until the led increases it's blinking frequency
5. release the remote control button, you're done!

(note that the software should be running in order to see the blue led on the back of the TURTLE once the emergency button is pressed)

[MirrorCompass.png](#) (218 KB)  Wouter Kuijpers, 04/07/2018 01:32 PM

[MICManager.png](#) (564 KB)  Wouter Kuijpers, 04/07/2018 01:57 PM

[NewBallCalibration.png](#) (596 KB)  Wouter Kuijpers, 04/07/2018 01:57 PM

[CalibrationGUI_1.png](#) (68.4 KB)  Wouter Kuijpers, 08/14/2018 05:05 PM

[CalibrationGUI_2.png](#) (97.1 KB)  Wouter Kuijpers, 08/14/2018 05:44 PM