

# UT AUSTIN VILLA - OPEN CHALLENGE

## AUTO-CALIBRATION OF MULTIPLE CAMERAS

Of the two cameras present on the Alderbaran Nao, the top camera is a perennially underutilized resource for many Robocup teams. We suspect that one of the main reasons for this neglect is the fact that under the default settings, the color of the image captured by the top camera differs significantly from that of the bottom. One solution would be to introduce a second color table exclusively for use on the top camera. However, this would require additional time to tune before each Robocup match.

The purpose of this challenge is to calibrate one camera well enough with respect to another camera so that a single color cube can be used for both. To solve this problem, we introduce a camera auto-calibration utility which tunes the hardware parameters (brightness, contrast, hue, etc) of the a given camera to achieve a match with another camera for some representative image. If the resulting parameters produce a good enough match, a single color cube can be used for both cameras.

The process of tuning the cameras is as follows: first, a representative snapshot from the static camera is saved. By representative we refer to an image which has non-negligible portions of each different color encountered during a game. Second, the tuned camera is aligned to match the saved image from the first camera. Lastly, the parameters of the tuned camera are learned via Hill Climbing. In each iteration, the segmented image captured by the tuned camera using the current set of parameters is compared to the saved image from the static camera. The match between the two images is scored by a percentage overlap for each segmented color present.

All computation is done on the actual robot at a rate of roughly 2 iterations per second. Hill Climbing typically converges after approximately 10 minutes. The quality of the resulting tuned camera parameters has been qualitatively found to be sufficiently well matched with respect to the static camera to use a single color cube for both cameras. Beyond just calibrating the top camera to match the bottom camera on a single robot, this tool is equally applicable to calibrating mutliple cameras on different robots to match a single camera. This would enable the use of a single color cube for a whole team of robots, greatly reducing the amount of time lost to manual color cube tuning before a match.

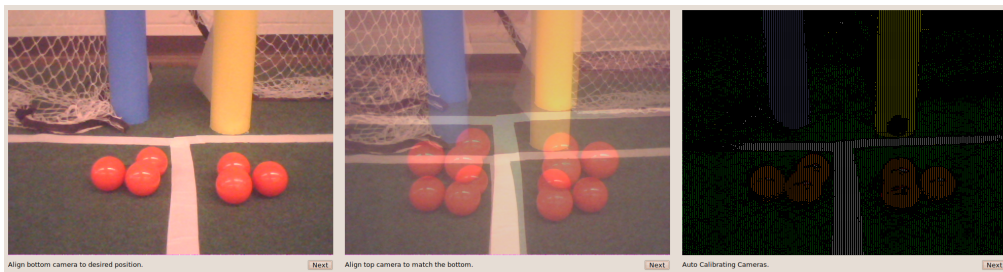


Figure 1: From left to right: Saving static camera image. Aligning tuned camera to matched static camera. Calibrating via segmented image