

Improving IR calibration in bee-CASU

Rob Mills, 9 Dec 2016.

Problem: IR sensors have different sensitivities, both within casu and between casus. This can result in systematic biases in experiments, especially when the casu controller is designed to amplify small differences to result in symmetry-breaking of the bees.

Sources of problem:

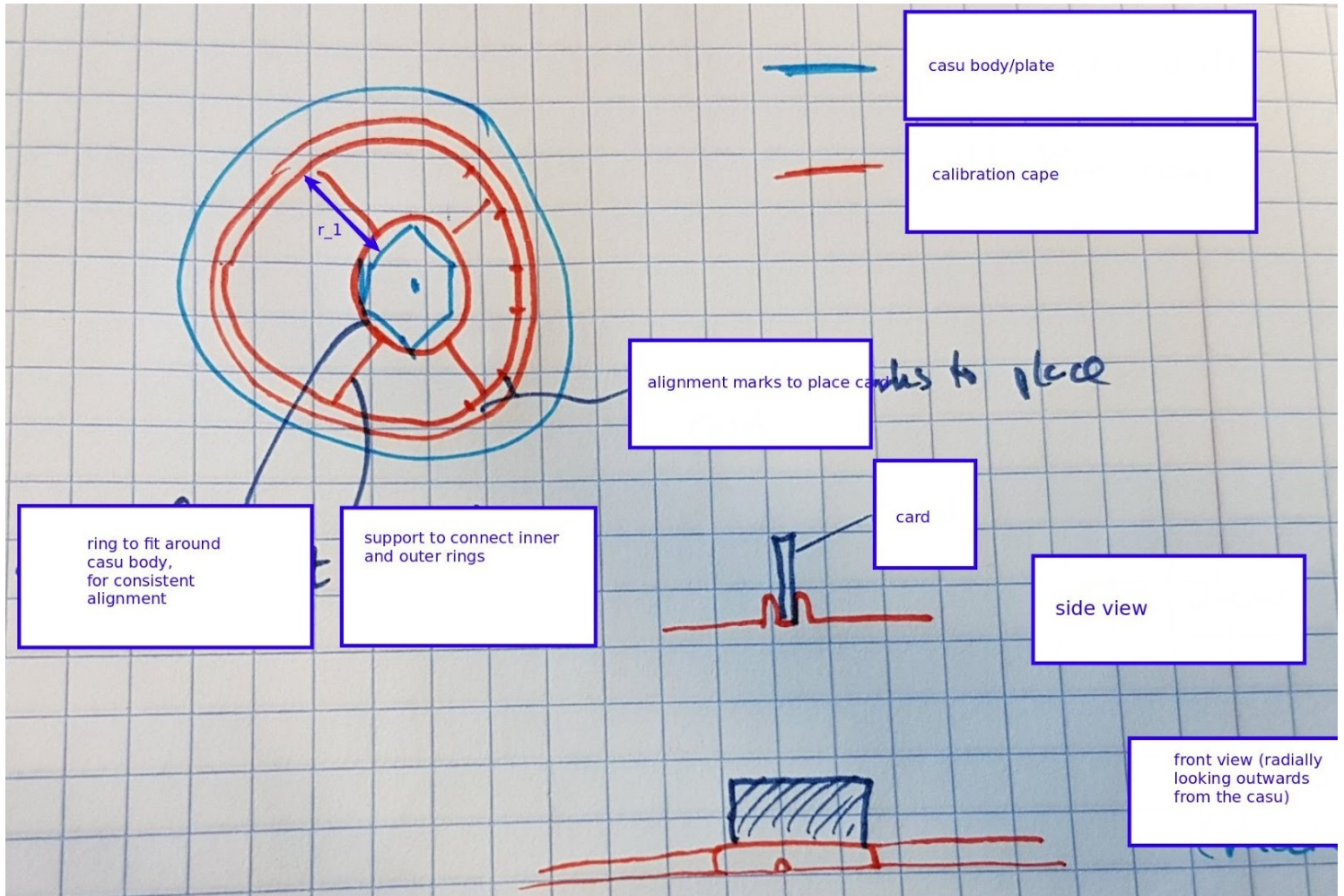
1. Defective sensors / connections
2. Sensors partially covered in wax
3. Tolerance in sensor mounting angle
4. Tolerance in sensor devices(?)

Detecting problems: We identify problems of type #1 by checking the extremes: does the sensor value change when a cone covers all sensors? Type #2 uses a similar procedure, with manual inspection that is massively improved with the GUI and well-tuned visual feedback.

Types #3 and #4 are more subtle, but currently we only have rather loose information to check this (e.g. data from ~20 experimental runs, giving 'typical' distributions of sensor activity, and then comparing whether any given casu or sensor is an outlier).

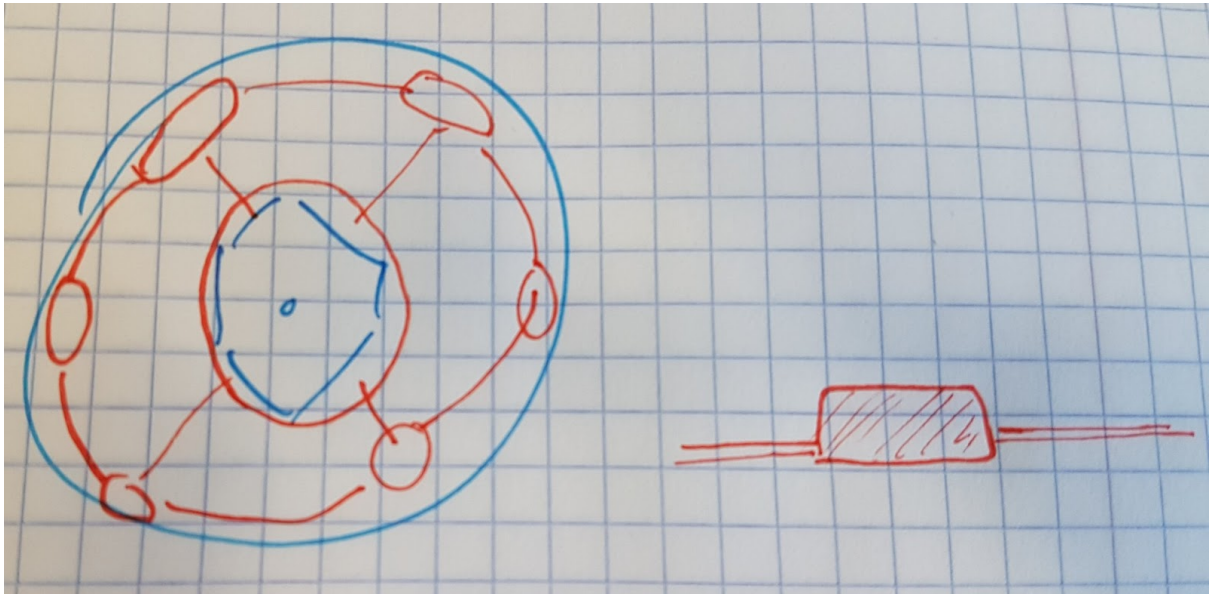
Without any measurement of the differences in response, we simply have to accept the variability; but with some measurements we should be able to choose thresholds, or other interpretation of the data, more appropriately.

Idea: use a (series of) plastic cape(s) that fits over the body of the casu, and makes an occlusion of known frontal area at a known distance. Then the fact that different sensors (whether on same casu or on different casu) report differently for identical objects can be better managed. R_1 is the radius of this cape; perhaps 2 or 3 different radii would provide a good amount of information but a single, well chosen radius could be enough.



Here, the outer ring of the cape is a guide to support inserting a piece of card; this will allow testing of various different sizes of occlusion - just by cutting different width/height of card - to identify the size of occlusion so that it is relevant, i.e. in the sensitive range.

In a later phase, this area can be replaced by plastic as an integral part of the cape. See fig 2 (v. badly drawn :)



The reason that the cape should not simply be a cylinder is because this will block too much of the IR signal, and likely not provide any discrimination between sensors mounted at different angles; and if it does, it still might not be relevant for bee-generated signals.

Simpler idea: However, perhaps a ring of low height could be sufficient? This is presumably easier to produce. It just needs the inner ring and supports for alignment, and the outer low cylinder.