March 2020

INFRARED LED COUPLING OF AN AUTONOMOUS DRONE FLIGHT MODULE WITH A CARGO OR PASSENGER MODULE ANDOR A DRIVE MODULE

Verena Blunder
Bertrandt Ingenieurbüro GmbH

INFRARED LED COUPLING OF AN AUTONOMOUS DRONE FLIGHT MODULE WITH A CARGO OR PASSENGER MODULE AND/OR A DRIVE MODULE

Technical task:
The subsequent technical development solves the task of an infrared LED-guided coupling of an autonomous drone flight module with a cargo or passenger module and/or a driving module, which functions independently of environmental influences.

Initial situation:
At present, multimodal offers of mobility concepts do not include a comparison of the current position of the coupling (e.g. pop up + or cargo-drone applications (Volocopter)) of the modules (flight module - cargo or passenger module + driving module, if applicable) which works in all operating conditions (dirt or ight conditions, etc.). Alignment or docking processes are usually based on QR code or on sight.

Figure 1

Figure 2

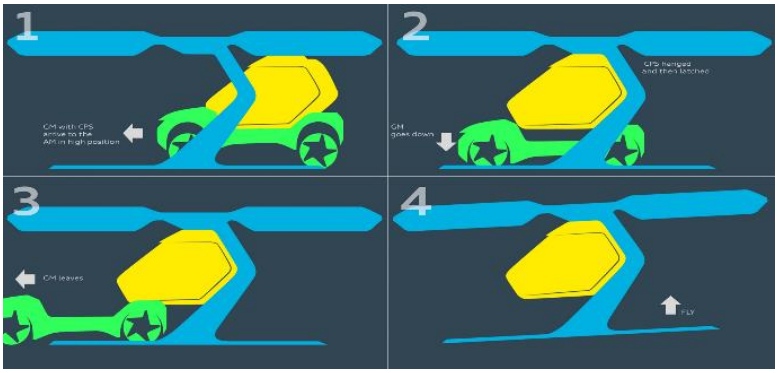

Figure 3

Solution:
One solution approach is the infrared-LED-guided coupling of the drone flight module with cargo or passenger module and/or with a driving module.

Advantages:
Infrared-guided LED coupling systems for autonomous drone modules are therefore largely independent of environmental conditions (dirt, light conditions, etc.). They can be used as a redundant system (certification AIR applications) for a QR Code guided coupling or "stand alone".

Possible application:
First investigations of these coupling processes on IR/LED basis were successful. The basis is a light-emitting source (LED) based on IR and a camera with IR filter (see Figures 4 and 5).

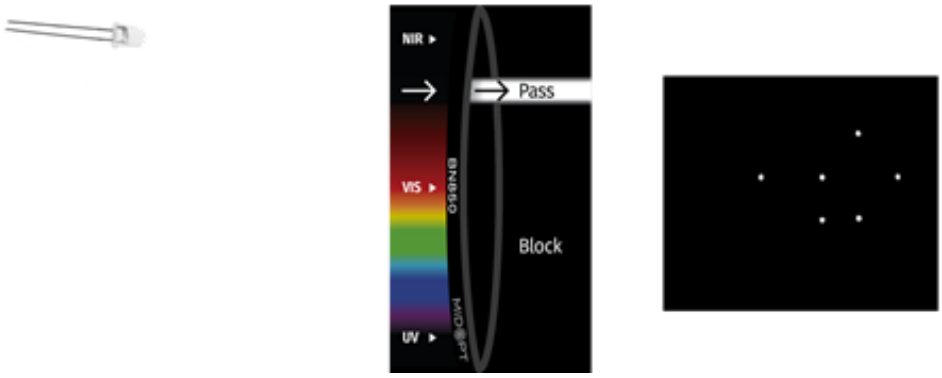

Figure 4

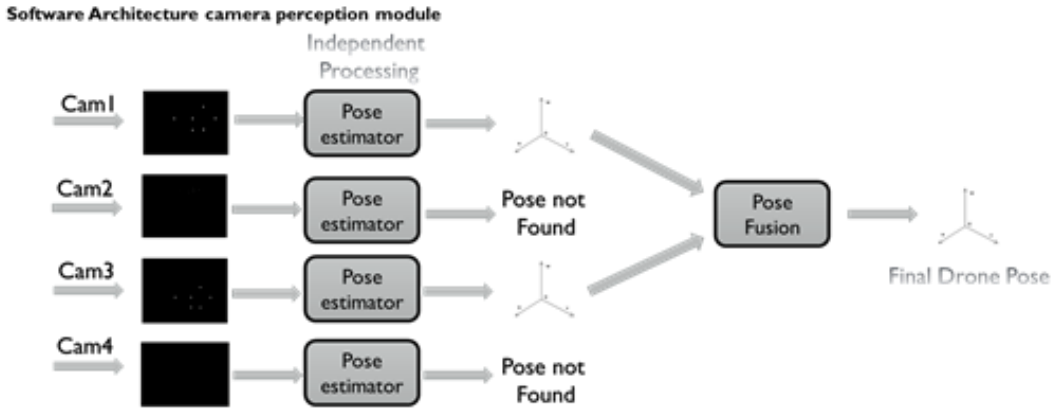

Figure 5

The IR camera (number to be defined according to the type of modules or coupling) and the IR LEDs (number different according to the type of modules or coupling) are shown as an example in Figure 6. The basic idea is to define a target image from the arrangement of the IR LEDs, which is compared with the image received by the IR camera via an algorithm with changing position of the module (coupling process). In the case of delta (target image to real-time image), a correction of the position is made (command to Drive-Train). Redundancy can be achieved via QR codes, which can also be captured by the camera as a target/ real-time image. In this case it is important to define a ranking of the systems in order to avoid incorrect information to Drive-Train (MASTER and SLAVE). An accuracy of +/- 5 mm can be achieved here. The arrangement of the IR-LED images is "package-oriented". Depending on the starting point (see Figure 7), at least one camera has a first image concerning the target guidance for the coupling procedure in the alignment. This then enables a guided alignment (further LED images stored in the position algorithm), which then reports the coupling position at the final position point ("last" LED image). The coupling process can thus be initiated with an accuracy of +/- 5 mm.

An arrangement (using for example 4 cameras + IR filter) including the alignment procedure can be seen in the following figures.

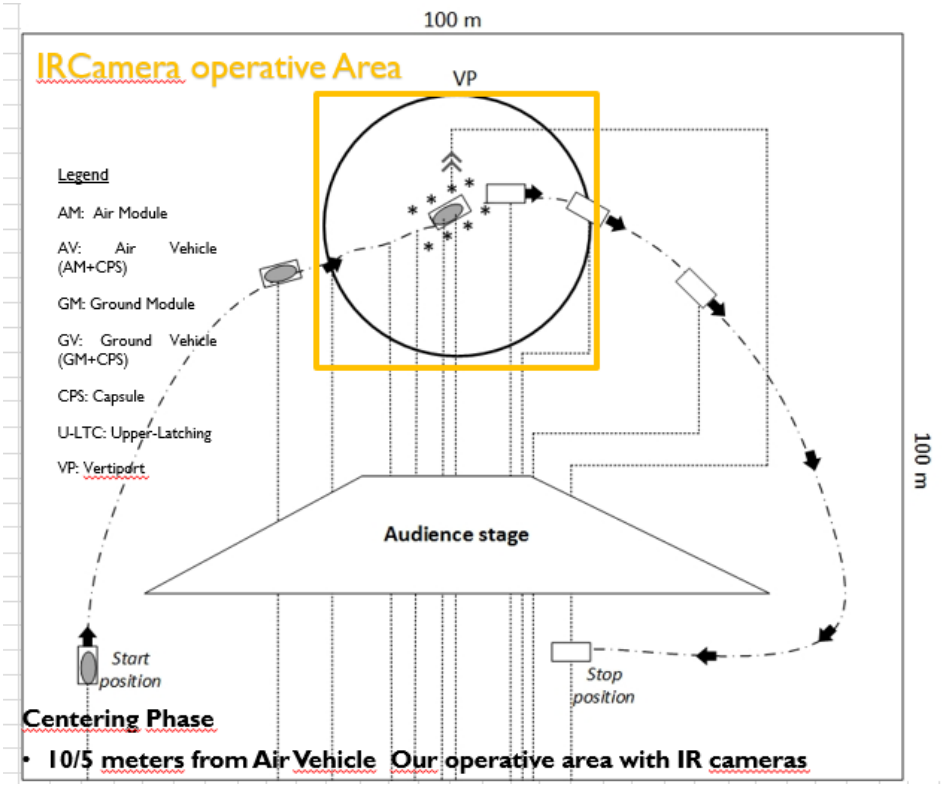

Figure 6

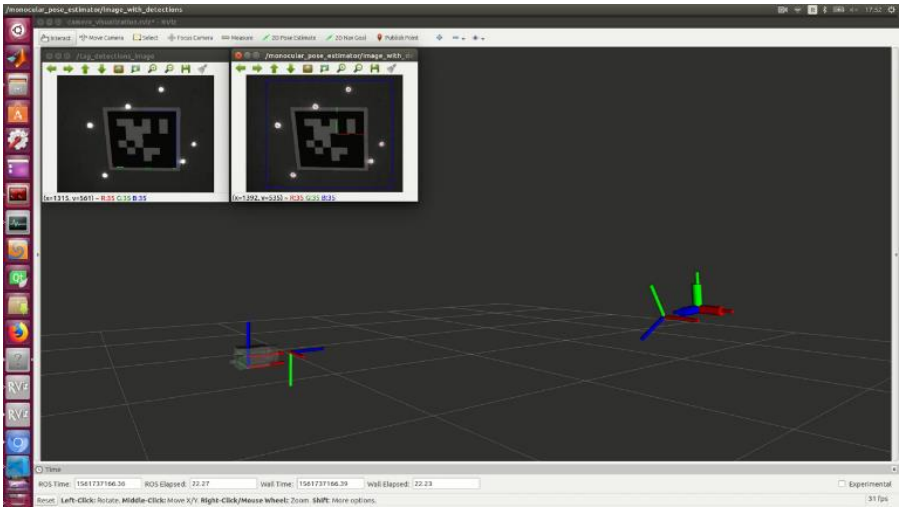

Figure 7

In the following, Figures 8-10 show examples of implementation that require autonomous coupling. A solution for this is not yet known.

Figure 8

Figure 9

Figure 10