S E S 2 0 1 7
Thirteenth International Scientific Conference
SPACE, ECOLOGY, SAFETY
2 – 4 November 2017, Sofia, Bulgaria

NOTES ON TEACHING EXPERIENCE GAINED THROUGH SIMLAT C-STAR SIMULATOR IN BULGARIA

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Key words: *operator, UAV, simulator, training, C-Star*

Abstract: *In the report hereby, topics related to training, evaluation, and selection of UAV operators are discussed. Experimental data taken from recent courses held by means of C-Star simulator of Israeli company SimLat are also presented. The flight task data are logged by means of PANEL module. Our teaching experience is shared, so is the trainees' performance.*

БЕЛЕЖКИ ПО ПРЕПОДАВАТЕЛСКИЯ ОПИТ НАТРУПАН ЧРЕЗ СИМУЛАТОР SIMLAT C-STAR В БЪЛГАРИЯ

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Ключови думи: *оператор, БЛА, симулатор, обучение, C-Star*

Резюме: *В настоящия доклад се обсъждат въпроси, свързани с обучението, оценката и селекцията на оператори на БЛА. Представени са експериментални данни, получени от наскоро проведени курсове на симулатор C-Star на израелската фирма SimLat. Полетната информация е събрана посредством модул Panel. Обсъден е преподавателският опит на авторите, както и успеваемостта на обучаемите.*

Preamble

Business and entertainment drone applications are all the rage these days in Bulgaria and worldwide. For example, the drones might be used in agriculture and forestry for observation purposes. On the basis of collected data, it might be decided when crops should be treated, the yield is forecasted, etc. Activities like coordinating forest fires extinguishing, medical care in the event of an accident, fight against hailstorms, and many others are also facilitated by drones. Unlike the recent past, drone applications are nowadays there for the taking.

In Bulgaria, the first aerial target drone was designed about 50 years ago, [1]. Many others have been produced since then. In order to get well trained, pilots are required to attend a preliminary training course including practicing at a simulator. Similarly, having realized the need of vocational UAV training, the managing body of Space Research and Technology Institute was persuaded into purchasing a UAV simulator. From among all received offers, SimLat's was rated as the best value for money. The simulator gives a crew the opportunity to carry out specific tasks solely related to typical UAV applications. The achieved results are topical and may be useful in further UAV teaching activity.

C-Star solution in the Space Research and Technology Institute

The Space Research and Technology Institute (SRTI) possesses a full crew solution of the C-Star simulator including a pilot station, a payload station, and an instructor station. The taught course is led by SRTI employees who have already been certified by SimLat in advance. The overall arrangement of the simulator within the laboratory is shown in following figure.

Fig. 1. The C-Star laboratory at the SRTI

Teaching method

Among wide variety of teaching methods, demonstrating, [2], was given the biggest priority for obvious reasons. Prior to practicing at any station, each trainee is shown a correctly performed task once. The task is performed by the instructor correctly. The trainee is expected to memorize as many details about task implementation as possible. Having confirmed readiness, the trainee is offered to be seated at the station and try to implement the task by her/himself. Immediate help is provided by the instructor if it is necessary. Should the trainee undergoes a crash, the flight task is started over again. This is repeated until the trainee achieves satisfactory result. Upon task completion, a short debriefing follows.

In 2016, about fifty employees from Bulgarian Ministries of Interiors and Defense attended educational courses at C-Star laboratory. Students were between 20 and 30 years old. Women made up about 10% of trainees' total number. Each student practiced maximum one hour per station and eventually took an exam. Among the students, there were several professional fighter pilots.

Initially, the students had to master basic piloting skills such as takeoff, flight on route, visual approach, and landing so as to get familiar with the pilot station. Having got used to fly, the students were assigned more difficult tasks. For example, distinguished students were asked to perform landing procedure with autopilot failure. In this way, the airplane attitude stabilization and Euler angles limitations are no longer available which is why the trainee has to make more effort to avoid crash landing. Severe weather conditions were also simulated to make steering the airplane even harder.

The students were assigned next task at the payload station. The task plan is depicted in Fig. 2. In this scenario, the payload operator has to detect and follow a moving ground target (T-72 medium tank). Both the airplane and the target move along a previously assigned route. Also, there are additional clues (accompanying vehicles) that let the operator figure out the target from a greater distance. The task goal is to lock the target within the sensor field of view (FOV) as soon as possible. Simultaneously, the Panel module records few performance parameters. The most important parameter is period of time within which the target falls into sensor FOV. The sooner student locks the target, the better. The task depicted in Fig. 2 is same for all trainees.

Finally, a crew training session was also carried out. The session consists of initial checklist, taxiing for take-off, take-off, flight en-route, task completion, landing approach, landing, and taxiing to parking area. It is worth mentioning that the only available video channel gives an impression of additional impediment to the crew trying to identify a ground object. Whenever the onboard camera is turned aside by the payload operator, it prevents the pilot from observing the front hemisphere and maintaining the right course.

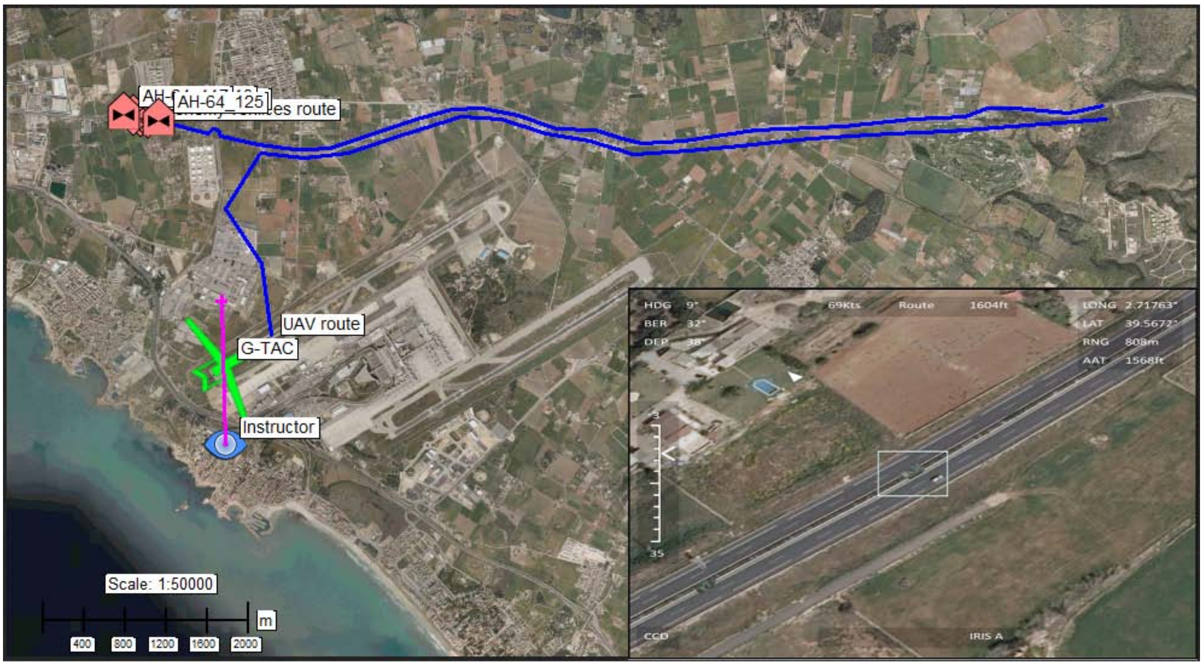

Fig. 2. Flight task scenario

Results

Graphs depicted in Fig 3, 4, and 5 show success rate of trainees carrying out a flight task at the payload station. The graphs are put together by means of the Panel module. The tested trainees are a professional pilot, Fig. 3, and two beginners, Fig. 4, 5. As it was mentioned earlier, the flight task comprises detecting and following a mobile ground target. In the figures, each curve provides information about following:

- Line 1: distance between the UAV and the target, m
- Line 2: distance between the line of sight and the target, m
- Line 3: payload field of view, deg
- Gray areas: the target is locked within the sensor field of view

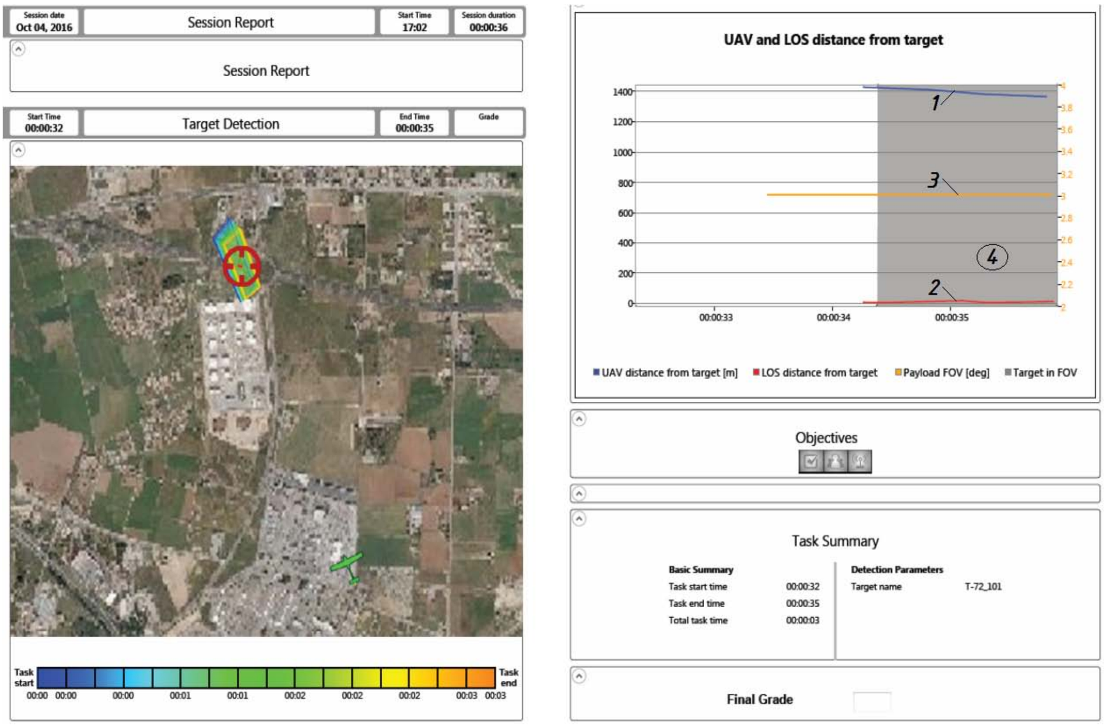

Fig. 3. Very good performance by a professional pilot

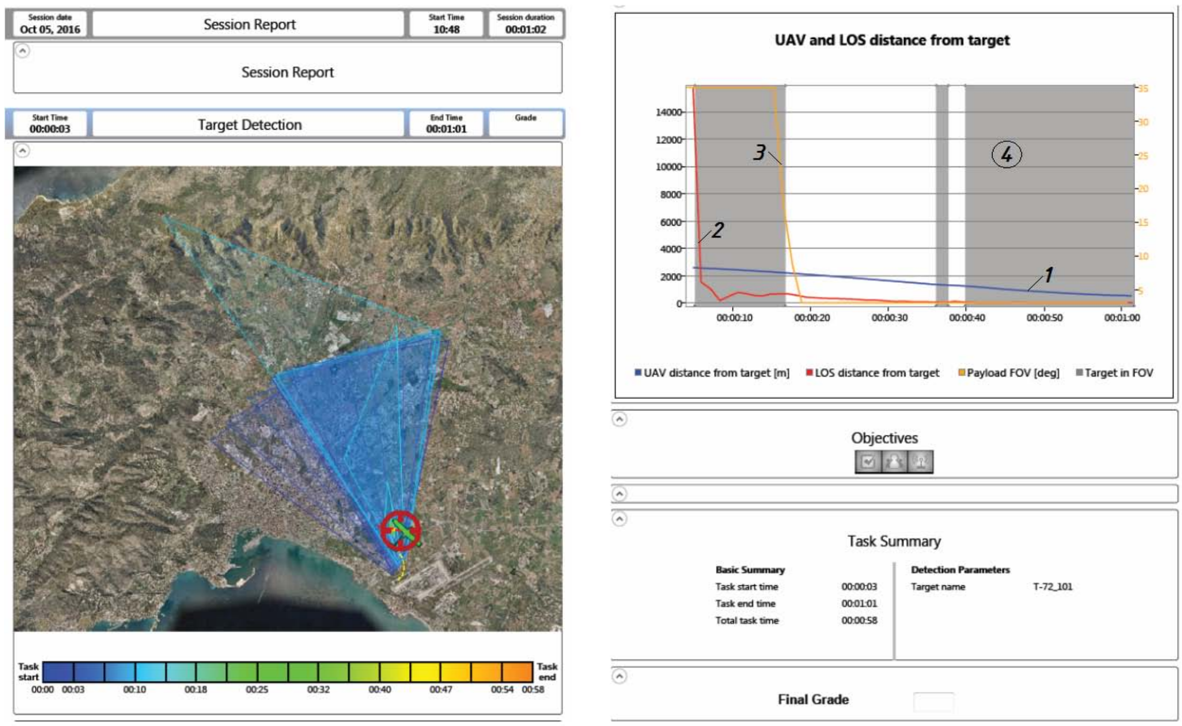

Fig. 4. Intermediate level achieved after initial training

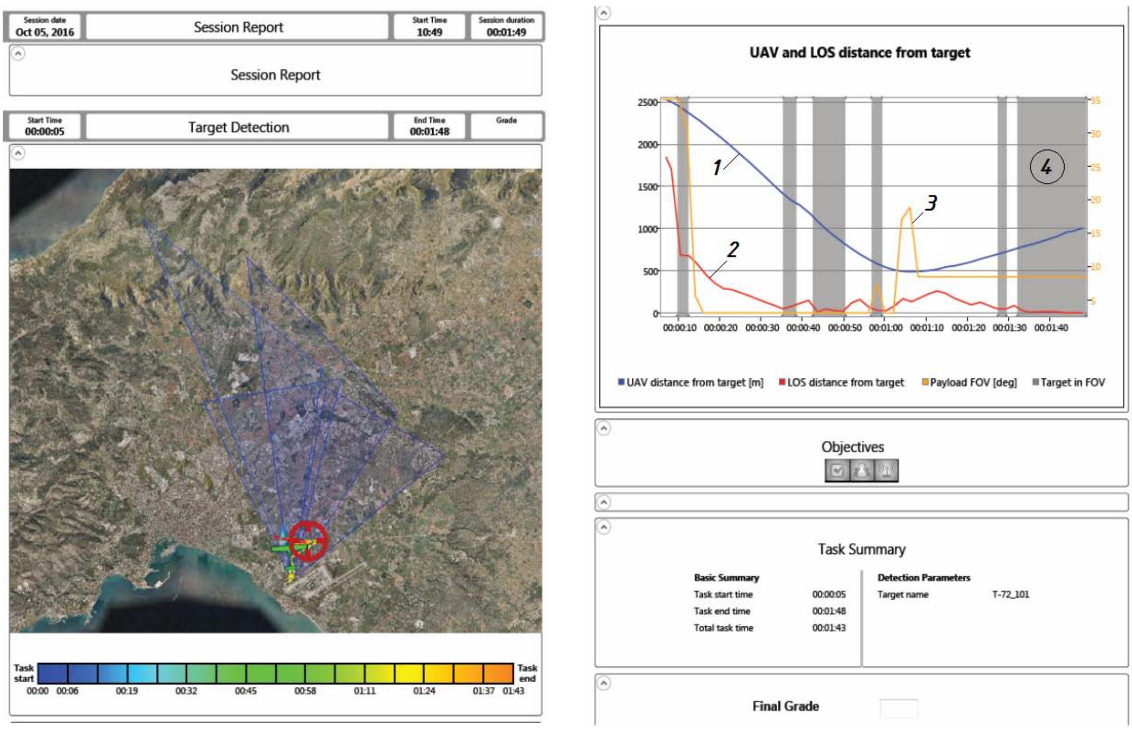

Fig. 5. Weak performance following initial training

Discussion

The achieved results indicate that successful trainees are either skilled professional operators (of UAV in particular) or play computer flight simulators on a regular basis. From figures above, it is evident that the professional trainee makes a single attempt at locking the target and succeeds at once. On the contrary, it takes the unexperienced beginner trainee more time to get used to the joystick and be quick on the uptake. Eventually, everybody succeeds. However, preliminary demonstration made by the instructor is strongly necessary. Having watched the flight scenario in advance, the trainee is less likely to make errors due to ignorance.

Another conclusion might be made that mastering the payload station appears to be a more arduous undertaking for all trainees. Working with the payload is a relatively long task taking a trainee up to a few minutes to complete. The underlying scenario involves performing vigorous maneuvers by the airplane which is why the line of sight shifts continuously. The trainee has to decide on a course of action quickly and figure out the new target location over again. What is more, the moving target is very elusive within a scene with small angular extent (a.k.a. small angle of view, zoomed-in window), which may happen right before triggering the locking button. On the other hand, it is impossible to lock the target within a zoomed-out scene of the video channel. All these pieces of subtlety are critical for successful performance because they burden the trainee's attention in addition.

In the C-Star simulator, there are five generic tasks that might be added to the scenario. These include target detection, static target observation, dynamic target observation, route scanning, and area scanning. In the course of task, the Panel module provides a mean of data logging and depicting the trainee's performance automatically. This is the only available tool for the purpose.

We would like to bring minor technical issues to reader's notice, Fig. 6. Whenever the payload operator happen to scan a large area, the corresponding FOV rectangle is depicted too large. We suggest that a kind of limiter should be introduced so as to cut off rectangles which exceed an initial size limit so as to preserve the overall minimum resolution of the scenario.

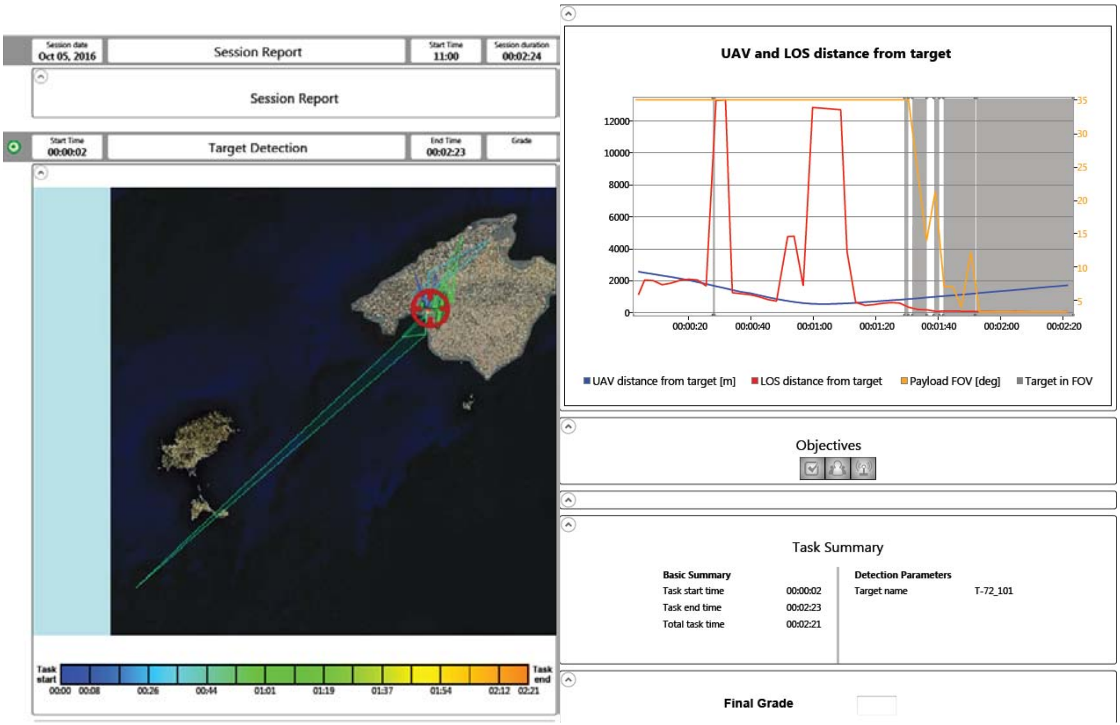

Fig. 6. Occasionally, the field of view rectangle appears excessively stretched (left half)

What lies ahead is putting a 3D map of Bulgaria together and installing it further in the C-Star simulator. Another improvement to come up with is making the flight dynamics model more plausible by expanding it within the bounds of possibility.

Reader is strongly advised to get acquainted with the C-Star manuals [3], [4], [5] so as to gain profound insight into the simulator theory and practice.

References:

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