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APPLICATION OF FLIGHT SIMULATOR FOR SELECTION OF PILOT-CANDIDATES.

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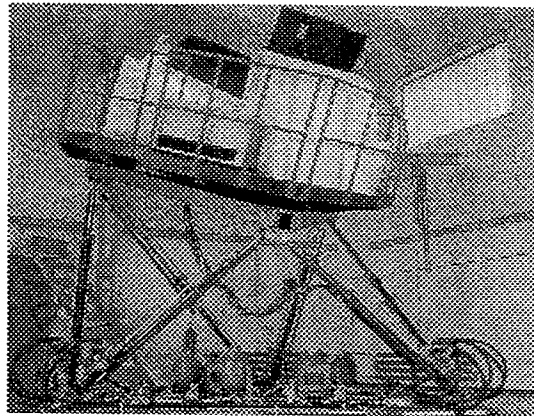
More and more frequent utilisation of flight simulators has recently become a world tendency in military and civil aviation, too. They are mainly used for basic pilots' training, to maintain flying habits and for training special tasks (e.g. combat missions), how to behave in emergencies and for selection of pilot – candidates.

Flight simulator enables training of motor, perception and decisive skills under conditions simulating a real situation. Thanks to the application of flight simulators, we can save 50% of training time, compared with the same conditions when simulators are not used. The costs of simulator training constitute about 8% of aircraft training. The costs of flight simulator exploitation and service, depending on the type and kind of trained skills are paid of within the period of 7 months – 2 years. (3)

Description of flight simulator and flight procedures for selection of pilot-candidates.

The simulator exploited in Polish Air Force Institute of Aviation Medicine (PAFIAM) since 1993 and denoted by JAPETUS cryptonym has been designed and constructed in Poland. It belongs to the category of the so-called complex simulators with the following exploitation characteristics:

Fig.1. Flight Simulator in PAFIAM



- flight simulation using a mobile platform enabling simulation of visual illusions, change of cabin position during real time (in 6 axes), according to the performed task
- complete imitation of cockpit equipment
- possibility to perform different training-combat task including taxiing on an airfield, start, aerobatics, landing, training selected air combat elements, destroying ground targets, etc.
- possibility of task simulation under selected weather conditions
- possibility of task simulation in different time within 24 hrs.
- possibility of simulating many selected kinds of failure of different aircraft subassemblies during the flight.

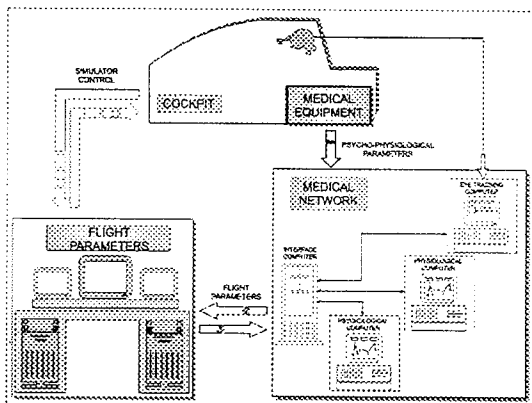
JAPETUS simulator is equipped with medical system whose main tasks are:

- recording basic physical flight indices,
- record of selected physiological signals: ECG (6 leads), breathing frequency, electromyographic (EMG) signal, skin resistance changes (Galvanic Skin Resistans-GSR)
- record of pilot's response time to auditory and visual stimuli (realisation of Wittenborn's psychological test)
- oculographic examination, record of eyeball movements during real time
- studying motor reactions through the analysis of stick and rudder-bar movement curves.

Evaluation of physiopsychological parameters in synchronised with the performed in-flight task – is correlated with such flight parameters as: velocity, altitude, flight phase, etc.(4)

Construction of the system enables application of new measurement blocks and software enrichment.

Medical System functional scheme is presented in Fig.2.



Simulator studies have numerous advantages from the point of view of methodology:

1. the level of flight programme difficulty allows the candidates with no knowledge about pilotage principles and flight simulators to realise this programme.
2. The flight programme is difficult enough to make distinction between pilot-candidates,
3. Programme construction allows to compare the results of simulator tests with the results of real flights on trainer aircraft.

Computer analysis of flight parameters is carried out during 2 stages: Stage 1 – automatic detection of different flight phases (phase name, onset and offset time, comparison with patterns), Stage 2 – automatic evaluation of performing different flight phases, based on the criteria worked out by flying instructors.

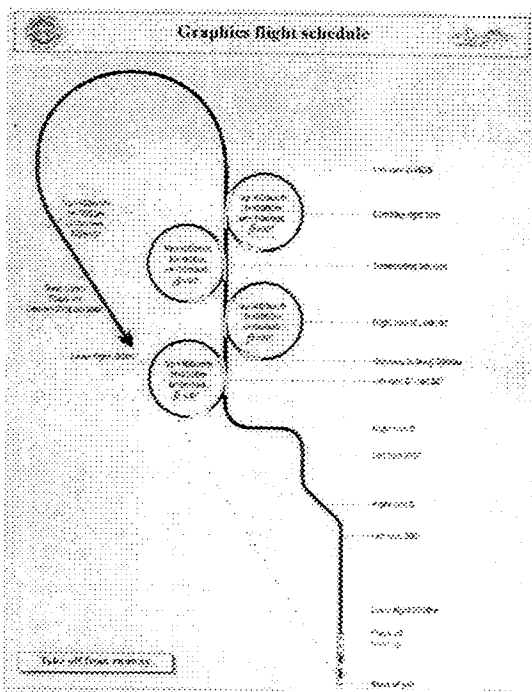
In selection program for pilot-candidates, computer analysis of flight parameters was applied, what enabled: making task evaluation objective and exempt the flight instructor from arduous flight analysis in real time.

The cycle of candidates' preparation for simulator studies and selective flight performance was realised in accordance with the following procedure:

- the studies were carried out in 2-days' cycle
- the cycle consisted of 5 flights (exercise 1, 2, 3, 4, 5) including one learning and 4 evaluated tasks,
- candidates were given task program on the day preceding the first study,
- before the initial practice flight, the subjects were shown video projection concerning simulator

- cabin equipment, placement and function of the devices and basic pilotage activities,
- the initial practice flight, lasting 30-40 min., was supervised by a flight instructor; the subject could communicate with the instructor by phone,
- during flights 2-5, there was no possibility of communication with the instructor; the subject had to perform the whole task by himself,
- flight 2-4 were performed without the hydraulic platform, and flight 5 – with the hydraulic platform.

Fig.3. Graphic flight schedule.



Constant pilotage elements were included in each flight, with higher difficulty level during the subsequent flight.

Analysis of the recorded physiological data and psychological tests results, was carried out in different computer program.

Simulator tests results were evaluated by comparison of the recorded parameter values with the expected value, respectively for all flight phases. The obtained results were evaluated using a 4-score scale, normally used by flight instructors.

Comparative studies on a flight simulator and during real flight.

Working out flight procedure on the simulator, that is similar to real flight conditions, and evaluation methods, enables comparison of the results obtained by the candidates during selective studies with the results of simulator training. This is one of important elements of Polish Air Force Academy (PAFA) pilot-candidates selection.

It has been assumed that there is a simple correlation between selective simulator study results and the results obtained during in-flight cadet training.

This indicates that the candidate, whose simulator study results are good, is expected to obtain good results during basic training. (1,2)

It has been assumed that there are three basic conditions verifying flight system on a simulator, related to the results of flight training, namely:

1. success in basic flight training – the so-called selective flights,
2. success in base flight training, namely – graduating from aviation academy,
3. Obtaining the 2nd category of pilot

The studies were conducted to compare the results obtained by the same group of cadets on JAPETUS flight simulator and during basic training on training-combat aircraft.

Simulator studies were performed in 80 PAFA pilot-candidates. The selection program included 4 evaluated flights on JAPETUS simulator, according to the above mentioned procedure.

2 simulator test results were analysed: the total score for 3 tasks (flights 2,3,4) and the total score for 4 tasks (flights 2,3,4,5).

The candidates examined on the simulator, after having completed the remaining required aeromedical studies and passing the exams, were allowed to continue air training. 64 of 80 cadets started air training at PAFA.

The cadets were trained on training-combat aircraft – TS 11 ISKRA and PZL – 130 ORLIK.

Before starting flights, 2 weeks' ground training was carried out, ended by an exam.

The method of flight evaluation was standardised. The evaluation was made by flight instructors. Two kinds of grades were accepted: school marks – 2-5 and score for different pilotage elements (exercises) from 10 to 20.

3 kinds of tasks were evaluated: simple pilotage flights, simple pilotage flights combined with pilotage of middle difficulty and pilotage flights of middle difficulty.

Beside the score for different in-flight tasks, the evaluation comprised spatial orientation, speed of learning new pilotage tasks, observing flight safety rules, radiocommunication and resistivity to gravitation.

The cadets, who had shown little progress during theoretical training and had got unsatisfactory marks for the three kinds of flights, were disqualified for further flight training and no longer examined.

The scores obtained by the cadets on the flight simulator were compared with the results of the same pilots obtained during basic air training.

Statistically important correlation was found between the results obtained on the flight simulator and the results obtained during basic air training.

The average grade for ground preparation to perform flights (ended by an exam) was correlated with group placement, after 4 simulator flights, on the so called ranking list. An important negative correlation was found – the lower placement on the ranking list (better result) the cadet gained after 4 simulator flights, the better results he obtained during ground preparation for flights.

The correlation between the scores obtained after 3 and 4 simulator flights and the score obtained after completing basic air training was analysed.

An important positive correlation was found between these variables. That means that the better result the cadet obtained during simulator training, the better were his results during air training.

Similar correlation were found after having compared ranking list placement and the group placement. The correlation value was 0.419. This correlation was important on the level < 0.010 .

Both simulator and real flights require similar psychophysical skills, defined as flight ability.

When analysing the results concerning correlation between simulator study results and the results obtained during basic air training, we can find a direct correlation between success in simulator training and success in basic air training. It means that basing on simulator training results, we can

anticipate, with high probability, success in air training.

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