2017 – 2018

Competition Task

www.newflyingcompetition.com

Organizer
Neues Fliegen e.V.
Hamburg University of Applied Sciences
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Contents

1 Introduction

The scientific model flying competition „New Flying Competition“ was created by the registered student association „Neues Fliegen e.V.“ in 2015. The competition is characterized by applying real world industrial aircraft design criteria and real world aircraft design processes to model aircraft design. During the competition the participating university teams are applying scientific rationale and methods which are to be documented in design reports.

Following aspects play a major role:

- Apply a real-world aircraft design process and real-world design criteria to a model aircraft.
- Apply knowledge and competences acquired at university in practice.
- Improve the competitors’ soft skills

2 Jury

The jury consists of representatives of the aviation industry.

3 Participating in the Competition

3.1 Prerequisites

Further details can be found in document “**Rules of the New Flying Competition 2018**“ at:

www.newflyingcompetition.com/apply

Note the registration steps listed on that internet page.

Deadline for the registration is **October 31st, 2017**. No team will be accepted after the deadline. The following requirements are a pre-requisite for the registration:

- Pre-register before October 31st, 2017.
- The registration form must be completely filled-in and signed by the team captain and all team members.
- Certificates of matriculation of each student team members have to be sent along with the registration form.
- The transaction of the registration fee must be confirmed by the organizer.

3.2 Registration Fee

The fee for participating in the competition consists of a lump sum per team independent of the number of team members and an amount per person in the team.

Item	€	Comment	Type
Starting fee	1000	Per team	Compulsory
Meals and transportation	125 p.p.	lunch and dinner, transport for company visits	Compulsory

4 Challenge

Modern civil aircraft are limited in size by airport dimensions, especially on parking position (80m x 80 m x 80 ft) at the aerodrome's terminal. Nevertheless, there would be an effort to overcome this limitation for reasons of higher aspect ratio of the aircraft's wing, which would increase performance and fuel efficiency and therefore decrease emissions to atmosphere. On the other hand, there could be some interest by aerodrome operators in reducing aircraft spacing on ground to higher airport capacities.

The competition's goal is to develop, manufacture and fly a model of a civil aircraft which can reduce the wingspan automatically on ground. The airplane configuration is not predetermined and is therefore left to a team's discretion. This means it is possible to design both conventional and unconventional configurations (e.g. classical wing-fuselage configurations or Box Wing-, Flying Wing- or Blended-Wing-Body configurations.)

The challenge is to comply with criteria occurring in real-world design processes. Based on typical reports from the aviation industry, the competitors must keep a record of their development progress.

An airplane model must not only be able to perform a sophisticated series of manoeuvres: prior to the flight all teams have to produce and hand in a science slam video on a topic to be defined.

The competition will be embodied in an exciting program realized by our sponsors.

4.1 Design Reports and Science Slam

Each team must submit two design reports and a science slam video within the period stipulated. Submission of all design reports is a prerequisite for the competition flights. Design reports and science slam video must comply with the guidelines given on:

www.newflyingcompetition.com/download

Report	Deadline for submission
Preliminary Design Report – PDR	December 18th, 2017
Final Design Report – FDR	July 31st, 2018
Science Slam video	August 13th, 2018

4.2 Model Specification

Item	**Specification**	**Remark**
Aircraft type	Civil aircraft of any configuration	Conventional, Box Wing, Blended Wing Body, Flying Wing, others
Airframe	Wing span and fuselage length are not specified by the regulations	
	Wingspan extension	The aircraft must be equipped with a system that allows it to automatically increase the wingspan
	Max. take-off weight < 23kg	Likely take-off weight is appr. 10kg
	Structural strength to withstand g-forces according to flight patterns, static load test and landing on solid runway.	
	Metal plate must be fixed to the airframe with engraved information on: Name, address, country	German law, to be specified later by organizers
Propulsion	Electric propulsion	Over-the-counter products only
	Multi-Engine	Propeller/Impeller
	Battery: Li-Po 18.5V 5Ah (5S)	Detachable for recharge
	Physical safety switch (circuit breaker) to prevent unintended engine start	Mandatory
Electronics	Over-the-counter-items only	
	Standard radio control system 2,4GHz	Certified for a use in Germany, with max. EIRP = 100mW
	Power supply for on-board GPS-Logger for speed and distance	6 mm gold plug, to be specified later by organizers
	No gyro-systems accepted	

4.3 Payload

The model must be capable to carry a payload with a mass of 2 kg. The payload is of box-form with dimensions given below and will be supplied by the organizer on the day of flight display. The team has to choose one payload box from the variants given in the table below and notify the organizer about the chosen variant.

	Payload bloc (PLB)		
Alternative	Length [mm] L	Width [mm] W	Height [mm] H
1	1800	240	140
2	1200	360	140
3	900	480	140
Mass [kg]	2		

PLB must be fully enclosed by the fuselage and must not be attached to the fuselage. The fuselage has to be designed in such way that the PLB can be removed. The PLB must be fixed during the flights.

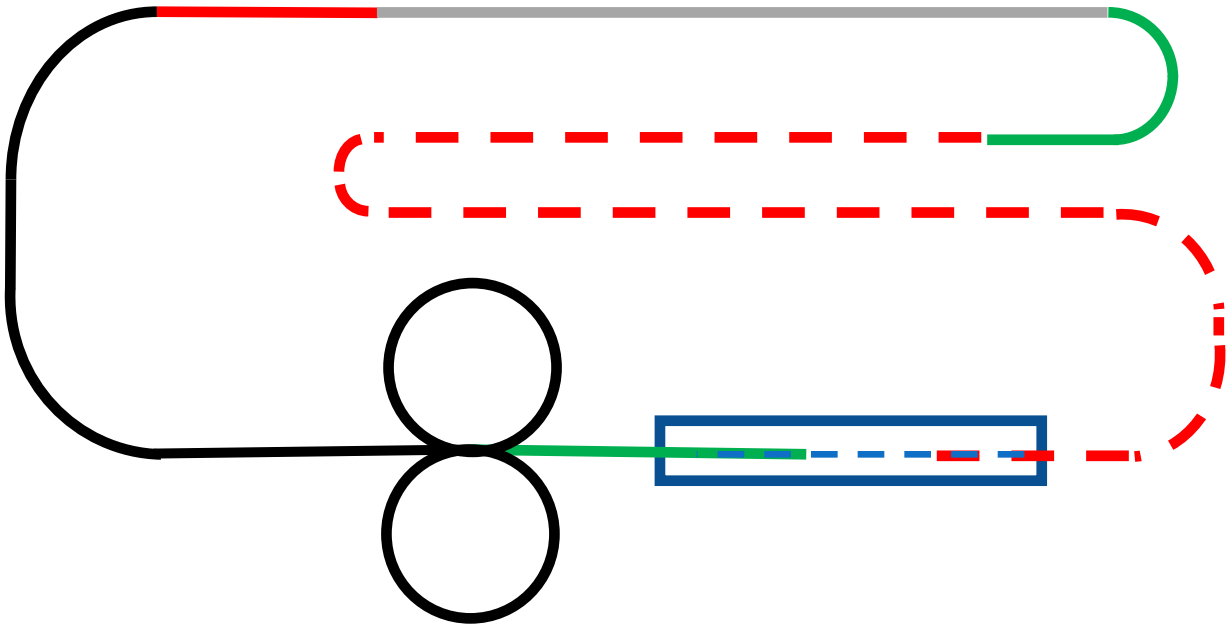
4.4 Competition Flights

Phase	Task	Monitoring
Charging	Charge battery	By jury
Flight 1	Payload box removed	By Jury Flight level and speed controlled by GPS-Logger Influence of wind will be considered by measured wind data and is minimised by two overflights, one in down- and one in upwind direction during max. speed demonstration Control of thrust during gliding flight by jury
	Automatic extension of wing-span, no external help allowed	
	Take-off against wind direction, no external take-off device allowed	
	Flight pattern:	
	360° left and 360° right circle turn, flight level 25m	
	Accelerate to maximum speed, flight level 20m	
	Climb to 100m and initiate gliding flight	
	Demonstrate gliding flight	
	Landing approach performed as gliding flight	
	Landing against wind direction	
Flight 2	Payload box installed	By Jury Flight level and speed controlled by GPS-Logger Influence of wind will be considered by measured wind data and is minimised by two overflights, one in down- and one in upwind direction during slow flight demonstration
	Automatic extension of wing-span, no external help allowed	
	Take-off against wind direction, no external take-off device allowed	
	Flight pattern:	
	Sine flight	
	Decelerate to minimum speed, flight level 20m, high-lift devices allowed, landing gear down	
	Landing against wind direction	

Post flight	Recharge battery only after second flight with same charger, measure recharged energy	By jury member
	Distance flown during both flights estimated from GPS-data.	By jury
	Specific energy consumption calculated: $\frac{\text{total recharged energy}}{\text{total ground distance (GPS) flown}}$	

4.4.1 Flight Pattern of Flight 1

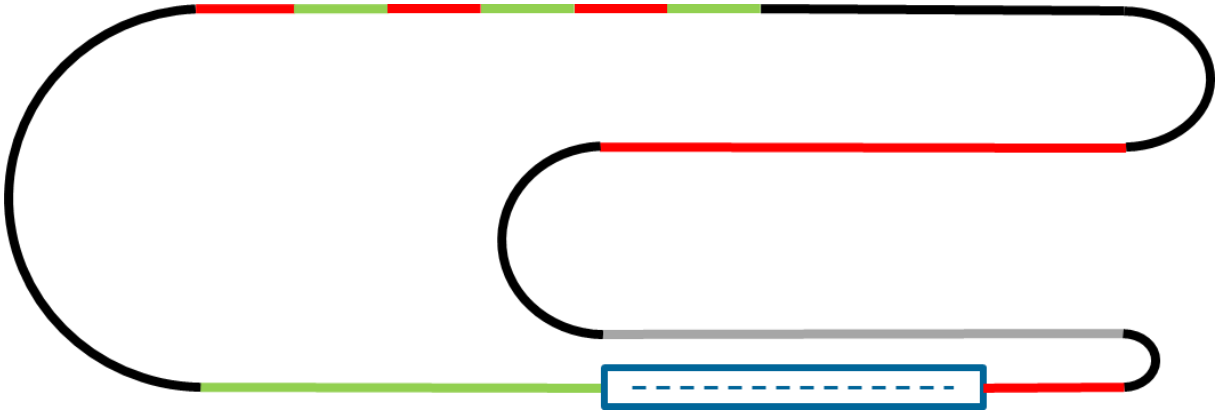
The aircraft operates without payload box weight. Before take-off the automatic functioning of the wing-span extension must be presented. Take-off with extended wing. Fly one 360° circle left and one 360° circle right at 25m altitude. Decrease height to 20m and perform flight at maximum speed possible. Then climb to 100m altitude and directly initiate gliding flight after reaching the mandatory flight level. Perform gliding flight in the admissible flight zone and execute landing while soaring. Throughout the whole gliding flight the thrust lever must be pulled down completely.



Flight pattern of flight 1

4.4.2 Flight pattern of Flight 2

The aircraft operates with payload box weight. Before take-off the automatic functioning of the wing-span extension hast to be presented. Take-off with wings extended. Climb up to 50 m. You must reach 3 times +3g vertical in sine-flight. Descent to a height of 20 m and perform flight at minimum speed possible. High-lift devices may be fully extended and landing gear must be down.



Flight pattern of flight 2

4.5 Scoring

Symbol	Meaning
S_{team}	Final scoring of a team
$S_{flights,team}$	Flight scoring of a team
$S_{reports,team}$	Scoring of all design reports incl. science slam of team
$S_{Report,jury\ member}$	Score given by a jury member for the PDR or FDR, respectively
$S_{science\ slam,jury\ member}$	Score given by a jury member for the science slam
$S_{science}$	Score given by a jury member with respect to the scientific content
$S_{performance}$	Score given by a jury member with respect to the creativity of the performance
n_1	Counter for successful automatic extension of wing span
n_2	Counter for successful sine flight
a_1	Additional points
$S_{Extention\ of\ Wingspan}$	Score for the extension of the wingspan
$S_{Efficiency}$	Score for the efficiency of the aircraft
$S_{Gliding}$	Score for the gliding performance of the aircraft
S_{Slow}	Score for the flight at minimum speed achieved
S_{Fast}	Score for the flight at maximum speed achieved
$S_{Landing}$	Score for the landing
$S_{circling}$	Score for the performance during 360° left-/righthand circles
P	Performance in a certain criterion
B	Wingspan
EC	Total energy consumption
Δx	Total distance flown during both competition flights
$\Delta x_{gliding}$	Distance covered during gliding flight
$\Delta h_{gliding}$	Height difference covered during gliding flight
$\emptyset v_{slow}$	Average speed during flight at minimum speed achieved
$\emptyset v_{fast}$	Average speed during flight at maximum speed achieved

4.5.1 Final Score

The more points you get in S_{team} the better is your ranking in the competition:

$$S_{team} = S_{flights,team} + S_{reports,team} \tag{1}$$

4.5.2 Flight Score

$$S_{flights,team} = n_1 \cdot n_2 \cdot (1 + a_1) \cdot \left[\begin{array}{l} \frac{S_{Extention\ of\ Wingspan}}{4} + 0.071 \cdot \left(S_{Efficiency} + S_{Gliding}\right) \\ +0.036 \cdot \left(S_{Slow} + S_{Fast}\right) + 0.018 \cdot \left(S_{Landing} + S_{circling}\right) \end{array} \right] \tag{2}$$

$$n_1 = \left\{ \begin{array}{ll} 1, & if\ automatic\ extention\ was\ successful \\ 0.3, & if\ extention\ was\ performed\ using\ manual\ help \\ 0, & if\ no\ successful\ extention\ was\ performed \end{array} \right\} \tag{3}$$

$$n_2 = \begin{Bmatrix} 1, & if\ g_{achieved} \geq +3g\ at\ least\ 3\ times \\ 0.5, & if\ g-load\ was\ not\ reached\ during\ sine\ flight \end{Bmatrix} \quad (4)$$

$$a_1 = Additional\ points\ of\ up\ to\ 5\%\ given\ by\ jury\ based\ on\ criteria\ like: \\ innovations, complexity\ of\ the\ aircraft, exceptional\ aerodynamics\ \ldots \quad (5)$$

Scoring of Criteria

Each criterion will be scored relative to the other teams. The best team in a criterion will get 100% for the certain criterion

$$S_{criterion,best\ team} = 1$$

$$S_{criterion\ ,Team\ X} = \frac{P_{Critierion,Team\ X}}{P_{Critierion,Best\ team}} \quad (6)$$

4.5.3 Scoring of performance in detail

The following scoring will be used to determine your performance for each task and the score will be calculated form this data as seen above:

$$P_{Extention\ of\ Wingspan} = \frac{b_{after\ extention}}{b_{before\ extention}} \quad (7)$$

$$P_{Efficiency} = \frac{\Delta x}{EC} \quad (8)$$

$$P_{Gliding} = \frac{\Delta x_{gliding}}{\Delta h_{gliding}} \quad (9)$$

$$P_{slow} = \frac{1}{\emptyset v_{slow}} \quad (10)$$

$$P_{slow} = \emptyset v_{fast} \quad (11)$$

$$P_{Landing} = \frac{\sum S_{landing,jury\ member}}{N}\ , N: Number\ of\ jury\ members \quad (12)$$

$$P_{circling} = \frac{\sum S_{circling,jury\ member}}{N}\ , N: Number\ of\ jury\ members \quad (13)$$

$S_{\text{landing/circling, jury member}}$ = Score of 1 to 5 given by jury member for landing/ circling performance whereby 5 is the best score

4.5.4 Report and science slam score:

$$S_{reports,team} = \frac{\overline{S_{FDR}}}{4} + \frac{\overline{S_{PDR}}}{8} + \frac{\overline{S_{science\ Slam}}}{8} \tag{14}$$

$$\overline{S_{FDR/PDR}} = \frac{\sum S_{Report,jury\ member}}{N} \quad ,N: Number\ of\ jury\ members \tag{15}$$

$$\overline{S_{science\ slam}} = \frac{\sum S_{science\ slam,jury\ member}}{N} \quad ,N: Number\ of\ jury\ members \tag{16}$$

$$S_{sience\ slam,jury\ member} = \frac{2}{3} S_{science} + \frac{1}{3} S_{performance} \tag{17}$$

The reports and the science slam are scored according to the following system by each jury member:

Letter grade	**Grade**	$S_{Report,jury\ member}$	**Meaning**
A+	0.7	1.05	Outstanding
A	1.0	1.0	Very good
A-	1.3	0.95	
B+	1.7	0.88	Good
B	2.0	0.83	
B-	2.3	0.78	
C+	2.7	0.72	Acceptable
C	3.0	0.67	
C-	3.3	0.62	
D+	3.7	0.55	Adequate
D	4.0	0.5	
F	5.0	0	Failed

5 General Time Table of the New Flying Competition

Date	**Activity**	**Remark**
October 31st, 2017	Deadline for registration	
December 18th, 2017	Submission: Preliminary Design Report - PDR	
Spring 2018	Announcement of science slam topic by advisory board. Check website	
July 31st, 2018	Submission: Final Design Report - FDR	
August 13th, 2018	Submission: Science slam video	
Competition Flights scheduled mid-September 2018		
Thursday	Registration 2:00 - 4:00 pm Social event afterwards	At HAW University of Applied Sciences, Hamburg
Friday	Mandatory model pre-check with respect to: • damages • safety and security issues	By jury member Mandatory: Team captain and model builder have to be present Minor repairs permitted
Saturday	Competition flights	Airfield near Hamburg
Sunday	Competition flights	Airfield near Hamburg
Monday	Company visits, ceremony for all teams	At HAW Hamburg

Check our document "Rules of the New Flying Competition 2018" for further details…