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 NFC
NEW FLYING COMPETITION

2020

Competition Task

www.newflyingcompetition.com

Organizer

Neues Fliegen e.V.

Hamburg University of Applied Sciences

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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 apply 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 five representatives of the aviation industry.

- Dr. Christoph Heß, Synergeticon GmbH
- Bernd Trahmer, Airbus Operations GmbH
- Roland Gerhards, Center of Applied Aeronautical Research
- Joachim Kienzler, Lufthansa Technik AG
- Christian Busch, Heinkel Group

3. Participating in the Competition

3.1 Prerequisites

Further details can be found in document “**Rules of the New Flying Competition 2020**“ at:

<https://www.newflyingcompetition.com/downloads/>

Please note the registration steps listed on that webpage.

The teams need to register via the given online-application-form. The official deadline for the registration is **October 31st 2019, 23:59 CET**. Once the deadline has passed it is only possible to request a participation directly via E-Mail to contact@newflyingcompetition.com. This application needs to be approved by NFC. In case the application is permitted, the team is obliged to comply with the regulatory deadlines for the reports and payments.

The application form can be found at:

<https://www.newflyingcompetition.com/apply-1/>

The registration is officially completed as soon as:

- The team captain has fully filled in the application form
- The applying team has received a confirmation E-Mail from NFC
- The team has paid the starting fee within four weeks after receiving the confirmation E-Mail

3.2 Registration Fee

For participating in the competition there are two fees to be paid: The starting fee is 1.000 Euros per team, regardless the number of team members plus a fee for meals and transportation in Hamburg which is 125 Euros per attendee. The starting fee needs to be paid within four weeks after receiving the registration confirmation E-Mail. The fee for meals and transportation needs to be paid three months in advance of the competition until 25th June 2020.

4. Challenge

The competition's goal is to design, build and successfully fly an aircraft model, capable of the defined mission. Based on typical reports from the aviation industry, the competitors must keep a record of their development progress.

4.1 The task

After successfully managing to remain faithful to its competition title regarding the development of original and challenging tasks over the past years, the organization team came up once again with an innovative approach of thinking about novel criteria that might play a key role in the design process of the aircraft of tomorrow.

At the end of 2017, the International Air Transport Association (IATA) published a prognosis which expects the annual worldwide air traffic to double from four to over eight billion passengers and posing a tremendous challenge to the entire aviation community. This will not only be faced by manufacturers, airlines or air traffic controls but also and not minor important by various airports around the globe. Airports that are already today starting to struggle keeping up with the capacity demands.

Nowadays, cities all around the world are becoming progressively populated so that available urban space is getting continuously diminished. The lack of space needed for infrastructure expansion and the increase of air traffic make it almost impossible to build and expand runways at existing city airports. Therefore, it is necessary to develop new ways of air mobility for connecting urban areas around the world.

We challenge the participants of New Flying Competition 2020 to elaborate an aircraft model design which combines the advantages of vertical take off and landing with the efficiency of a fixed wing aircraft during cruise flight and subsequently realize and present their design in form of a model aircraft at the competition day.

The aircraft model will not only have to perform a sophisticated series of flight manoeuvres and proof its efficiency at the day of competition, the teams' performance will also be rated by additional requirements like design reports comprising their approaches and concept elaborations.

The final competition weekend event will hold an exciting program for all participants funded and realized by our sponsors.

Annotation:

In general, the aircrafts' configuration is not predetermined and is therefore left to the teams' discretion. Note that the aircraft needs to be entirely designed and built by the competing teams. Modifying a commercially available aircraft or involving a non-academic third-party is not permitted.

4.2 Design Reports & Presentation

Each team must submit two design reports and a presentation until the given deadlines. Submission of all design reports is a prerequisite for the competition flights. The presentation must be held during the competition days. Design reports and presentation must comply with the guidelines given later on:

www.newflyingcompetition.com/download

Report	Deadline for submission
Preliminary Design Report – PDR	January 31 st , 2020
Final Design Report – FDR	July 31 st , 2020
Submission of presentation slides	September 10 th , 2020

4.3 Model Specification

Item	Specification	Remark
Aircraft type	Civil fixed-wing aircraft of any configuration with VTOL capability	Conventional, Box Wing, Blended Wing Body, Flying Wing, others
Airframe	Wing span and fuselage length are not specified by the regulations	
	Max. take-off weight < 25kg	
	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	
	Multi-Engine	Propeller/Impeller
	Battery: Li-Po of your choice with XT-90 connector	Detachable for recharge
	The battery / batteries powering the propulsion unit may not power any other electrical components	
	Physical safety switch (circuit breaker) to prevent unintended engine start	Mandatory
Electronics	Standard radio control system 2,4GHz	Certified for use in Germany, with max. EIRP = 100mW
	Power supply for on-board GPS-Logger for ground speed and distance	6 mm gold plug, to be specified later by organizers
	Gyro- and autopilot systems accepted	

4.4 Payload

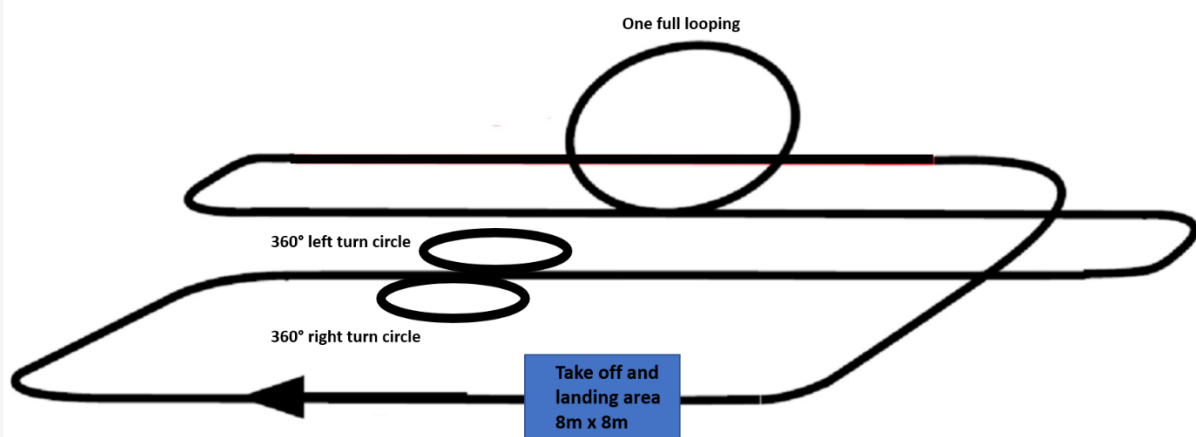
The model must be capable to carry a payload with a mass of 2 kg. The payload is of box-form with dimensions given below and will be supplied by the organizer on the day of flight display.

Payload bloc (PLB)		
Length [mm] L	Width [mm] W	Height [mm] H
1100	250	150

PLB must be fully enclosed by the fuselage and cannot 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 flight. The PLB must be horizontal positioned.

4.5 Competition Flight

Phase	Task	Monitoring
Charging	Charge battery with charger	By jury
Preparation	Install payload box	By jury
Taxiing	Aircraft must be able to taxi from holding point to takeoff position by itself	By jury
Flight	Vertical take-off from take-off and landing area (8 m x 8 m), climb vertically to minimum height of 10 m	By jury Flight level and speed controlled by GPS-Logger
	Transition to cruise flight (horizontal flight)	
	Flight pattern:	Influence of wind will be considered by measured wind data and is minimised by performing the cruise flight in down- and upwind direction. Maximum wind speed < 10 m/s
	360° left and 360° right turn circle	
	One full looping	
	Cruise flight: minimum flight speed of 60 km/h over ground, duration of 15 minutes	
Decelerate and vertical landing (from 10 m) in take-off and landing area (engine powered landing)		
Taxiing	Aircraft must be able to taxi from landing point to holding point by itself	By jury
Post flight	Damage check (aircraft must be fully functional after landing)	By jury
	Recharge battery after flight with same charger, measure recharged energy	By jury
	Distance flown during flight estimated from GPS-data	By jury
	Specific energy consumption calculated: $\frac{\text{total recharged energy}}{\text{total ground distance (GPS) flown}}$	



Flight pattern

5. Scoring

Symbol	Meaning
S_{team}	Final score of a team
$S_{flight,team}$	Flight score of a team
$S_{reports,team}$	Score of all design reports incl. the presentation
n_1	Counter for successful looping
n_2	Counter for adequate cruise speed
n_3	Counter for adequate flight time
n_4	Counter regarding the type of take-off/landing performed
$S_{Efficiency}$	Score for the efficiency of the aircraft
S_{VTOL}	Score regarding the performance during take-off and landing
$S_{Flight\ behaviour}$	Score regarding the general flight behaviour of the aircraft
$S_{Innovation}$	Score regarding the amount of innovation and complexity of the aircraft
P	Performance in a certain criterion
Δx	Total horizontal distance covered during competition flight
EC	Total energy consumption
$S_{Report,jury\ member}$	Score for the PDR or FDR, given by a jury member
$S_{Presentation,jury\ member}$	Score for the presentation, given by a jury member

Final score:

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

$$S_{team} = S_{flight,team} + S_{reports,team} \quad (1)$$

Flight score:

$$S_{flight,team} = n_1 \cdot n_2 \cdot n_3 \cdot n_4 \cdot [50 \cdot S_{Efficiency} + 12,5 \cdot S_{VTOL} + 12,5 \cdot S_{Flight\ behaviour} + 15 \cdot S_{Innovation} + 10 \cdot \Delta P] \quad (2)$$

Prefactors:

$$n_1 = \left\{ \begin{array}{l} 1: \text{if looping is performed successfully} \\ 0.5: \text{if no looping is performed successfully} \end{array} \right\} \quad (3)$$

$$n_2 = \left\{ \begin{array}{l} 1: \text{if } v_{average,CR} \geq 60 \text{ km/h} \\ 1 - \left(\frac{60 \text{ km/h} - v_{average,CR}}{60 \text{ km/h}} \right): \text{if } v_{average,CR} < 60 \text{ km/h} \end{array} \right\} \quad (4)$$

$$n_3 = \left\{ \begin{array}{l} 1: \text{if } t_{CR} \geq 15 \text{ min} \\ 1 - \left(\frac{15 \text{ min} - t_{CR}}{15 \text{ min}} \right): \text{if } t_{CR} < 15 \text{ min} \end{array} \right\} \quad (5)$$

$$n_4 = \left\{ \begin{array}{l} 1: \text{if VTOL is successful} \\ 0.3: \text{if STOL is performed} \\ 0: \text{if conventional takeoff and/or landing is performed} \end{array} \right\} \quad (6)$$

Absolute criteria:

$$S_{Innovation} = \frac{\sum P_{Innovation, jury member}}{N \cdot 5}, N: \text{Number of jury members} \quad (7)$$

$$P_{Innovation} = \text{Score of 0 to 5 given by each jury member for innovation and complexity of the aircraft, whereby 5 is the best score} \quad (8)$$

$$\Delta P = 1 - \left| \frac{P_{Prediction}}{P_{Efficiency}} - 1 \right| \quad (9)$$

$$P_{Prediction} = \frac{\Delta x}{EC}, \text{ prediction from FDR} \quad (10)$$

Relatively scored criteria:

Each criterion other than $S_{Innovation}$ will be scored relative to the other teams. The best team in a criterion will get 100% for the certain criterion. $S_{criterion, best team} = 1$

$$S_{criterion, Team X} = \frac{P_{criterion, Team X}}{P_{criterion, Best team}} \quad (11)$$

Scoring of performance in detail:

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

$$P_{Efficiency} = \frac{\Delta x}{EC}, \text{ during competition flight} \quad (12)$$

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

$$P_{Flight behaviour} = \frac{\sum P_{circling, jury member}}{N}, N: \text{Number of jury members} \quad (14)$$

$$P_{VTOL/Flight behaviour} = \text{Score of 0 to 5 given by each jury member for performance during VTOL and general flight behaviour whereby 5 is the best score} \quad (15)$$

Report and Presentation Score:

$$S_{reports, team} = 50 \cdot \overline{S_{FDR}} + 25 \cdot \overline{S_{PDR}} + 25 \cdot \overline{S_{Presentation}} \quad (16)$$

$$\overline{S_{FDR/PDR}} = \frac{\sum S_{Report, jury member}}{N}, N: \text{Number of jury members} \quad (17)$$

$$\overline{S_{Presentation}} = \frac{\sum S_{Presentation, jury member}}{N}, N: \text{Number of jury members} \quad (18)$$

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

Letter grade	Grade	$S_{Report, jury member}$	Meaning
A+	0.7	1	Outstanding
A	1	0.95	Very good
A-	1.3	0.9	
B+	1.7	0.85	Good
B	2	0.8	
B-	2.3	0.75	
C+	2.7	0.7	Acceptable
C	3	0.65	
C-	3.3	0.6	
D+	3.7	0.55	Adequate
D	4	0.5	
F	5	0	Failed

6. General Time Table of the New Flying Competition

Date	Activity	Remark
December 31 st , 2019	Deadline for registration	
January 31 st , 2020	Submission: Preliminary Design Report - PDR	
June 25 th , 2020	Payment: meal and transportation fee Submission: registration of team members	
July 31 st , 2020	Submission: Final Design Report - FDR	
September 10 th , 2020	Submission of presentation slides	
Competition September 24 th -28 th , 2020		
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: <ul style="list-style-type: none"> • 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, award ceremony for all teams	At HAW Hamburg

Check our document “Rules of the New Flying Competition 2020” for further details.