



ABCDEF



Scientific Report

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| First name / Family name | Andrea Cristofaro |
| Nationality | Italian |
| Name of the <i>Host Organisation</i> | NTNU |
| First Name / family name of the <i>Scientific Coordinator</i> | Tor Arne Johansen |
| Period of the fellowship | 01/04/2014 to 31/07/2015 |

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

Research project: Icing detection and identification for unmanned aerial vehicles.
The accretion of ice layers over airfoils and control surfaces affects dramatically manoeuvrability and stability of small aircrafts. Standard anti-icing and de-icing systems are not suitable for small unmanned vehicles. Novel and promising approaches to this problem have been proposed based on carbon nanotubes technology. To enhance the efficiency of such systems, the availability of a robust icing detection and identification module is desirable.

Main achievements:

- 1) Modeling of icing effects on aircraft dynamics
- 2) Unknown Input Observer approach for icing detection
- 3) Multiple-Model approach for icing identification
- 4) Improvement of the estimation accuracy using LPV methods
- 5) Control allocation methods for icing recovery
- 6) Wind and Angle-of-Attack estimation using standard sensors



II – PUBLICATION(S) DURING YOUR FELLOWSHIP

1. Cristofaro and T.A. Johansen, An unknown input observer approach to icing detection for unmanned aerial vehicles with linearized longitudinal motion, American Control Conference 2015
2. Cristofaro, T.A. Johansen and A.P. Aguiar, Icing detection and identification for UAVs: multiple-model adaptive estimation, European Control Conference 2015
3. T.A. Johansen, A. Cristofaro, K.L. Sørensen, J.K. Hansen and T.I. Fossen, On estimation of wind velocity, angle-of-attack and sideslip angle of small UAVs using standard sensors, International Conference on Unmanned Aircraft Systems 2015.
4. Cristofaro, M. Polycarpou and T.A. Johansen, Fault diagnosis and fault-tolerant control allocation for a class of nonlinear systems with redundant inputs, IEEE Conference on Decision and Control 2015.
5. D. Rotondo, A. Cristofaro, T.A. Johansen, F. Nejjari and V. Puig, Icing detection in unmanned aerial vehicles with longitudinal motion using a LPV unknown input observer, Multi-Conference on Systems and Control 2015.

III – ATTENDED SEMINARS, WORKSHOPS, CONFERENCES

- December 15-17 2014, IEEE Conference on Decision and Control, Los Angeles, US
- February 9-10 2015, AMOS Workshop, Oppdal, Norway
- July 1-3 2015, American Control Conference, Chicago, US
- July 15-17 2015, European Control Conference, Linz, Austria

IV – RESEARCH EXCHANGE PROGRAMME (REP)

- May 19-23 2014, University of Porto.
Contact person: professor Pedro Aguiar, pedro.aguiar@fe.up.pt.
Main topics: fault-tolerant control of autonomous vehicles, multiple-model adaptive estimation.
- January 19-24 2015, University of Cyprus.
Contact person: professor Marios Polycarpou, mpolycar@ucy.ac.cy.
Main topic: fault detection for nonlinear systems.