18. UCRAN; Cranfield University

Contributions to GRAIN2

KGT1 and KGT3 contributor

UCRAN – Cranfield University

- Wholly postgraduate university specialising in science, technology, engineering and management
- Cranfield has been at the forefront of aerospace development for nearly 70 years and brings together the disciplines of aeronautical engineering, materials, manufacturing and management to create new solutions for the industry

Technical contribution

KGT1: to develop a better understanding of the fundamental science and the physical processes in

Contrails - formation of a contrail, specifically the mixing process that takes place between the jet engine exit plane and the point where the fully mixed plume is established.
- penalty for avoiding contrails by flying at different altitudes to avoid the supersaturated air

NOx - survey new technologies associated with further reducing emissions in the LTO cycle to improve airport capacity, and the potential for technology to reduce cruise NOx

KGT3: to design, model and test of novel composite materials and efficient structures
- design and applications to airframe structures
- durability and damage tolerance (fatigue, impact, delamination)

Current Projects

- CleanSky: efficent engine design for emmision reduction; contrails and NOx models; Flight trajectory research and aircraft systems
- Airstream: integral airframe strucutres with bonded crack retarders
- Bridging the Divide: joining composites to metals to enhance performance and damage tolerance
- COINS: cost effective integral metallic structures using friction stir welding process
- SADE: integrated wing with morphing high lift devices

Future activities

- Novel solutions for strucutral integrity, e.g. fibre tow steering, through-thickness reinforcement
- Bio-sourced composite materials: mechanical performance investigation
- Thermoplastic composites: performance
- Development of models and methods for design analysis (fatigue damage model, impact model)
- Hybrid material structures: joining methods and performance
- Light-weight metallic structures: by welding, adhesive bonding, additive manufacturing

Selected Publications (related to GRAIN2 objectives)

- Poll DIA. The optimum aeroplane and beyond, The Aeronautical Journal, 113 (2009): 151-164
- Poll DIA. On the effect of stage length on the efficiency of air transport, The Aeronautical Journal, 115 (2011): 273-283
- Poll, DIA. A first order method for the determination of the leading mass characteristics of civil transport aircraft, The Aeronautical Journal, 115 (2011): 257-272
- Zhang X, Boscolo M, Figueroa-Gordon, Allegri G, Irving PE. Fail-safe design of integral metallic aircraft structures reinforced by bonded crack retarders. *Engineering Fracture Mech* 76 (2009) 114-133
- Zhang X, Bianchi F, Liu H. Predicting low-velocity impact damage in composites using a cohesive fracture model, The Aeronautical Journal, 116 (2012): 1367-1381
- Bianchi F, Zhang X. A cohesive zone model for predicting delamination suppression in z-pin reinforced laminates, *Composite Sci & Tech* 71 (2011) 1898–1907

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