Technical evaluation
of
WakeNet2-Europe WG7 Workshop
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- The objective of the workshop was to focus on the physics of wake alleviation principles. The objective was fulfilled, thanks to an active participation of all attendants. The participation of colleagues from the US was particularly appreciated. A large panel of participants included aerospace research centres, universities, or aircraft industry. Local organization by ONERA was excellent.

- The good technical level of the presentations demonstrated the quality of the scientific approach taken on the subject by the various research centres/universities. In general, the emphasis was put on the understanding of the wake vortex alleviation principles, as many fundamental aspects of the various principles mentioned are not yet fully controlled.

- The main principles for wake alleviation that have been presented and discussed were:
  1- Alleviation potential of using near field dynamics: vortex merging, jet/vortex interaction
  2- Wing add-on devices
  3- Wing loading modifications
  4- Active wake excitation

Most of the principles refer to the instability properties of vortex systems or vortices interacting with jets, confirming the need for fundamental research to improve the level of understanding.

- Short summary of the presented principles of wake alleviation principles.

1- Potential in near field dynamics:
Three-dimensional vortex merging of co-rotating vortices through short wave instabilities affects the near field dynamics by enlarging the vortex core at low Reynolds number. This effect may be slightly beneficial for wake hazard reduction. Numerical studies on vortex merging seem to indicate that the vortex velocity profile obtained after merging is independent from the initial vortex profile.
Recent theoretical studies indicate that the potential of engine jet/vortex interaction is limited, due to the powerful stability characteristics of isolated vortices.

2- Wing add-on devices: some devices studied experimentally have been shown do modify the vortex core structure, most of them have no measurable effect. The effect is device-dependant and seems to scale with the size of the device.

3- Wing loading modifications: this was the main high-light of the meeting, with special focus on wake alleviation principle through interaction of multiple vortex systems (medium and long wave instabilities). Theoretical, experimental and numerical studies have been presented, showing the high potential of the physical principle through quantification of the accelerated vortex strength decay. The efficiency of these principles in realistic environment has been assessed. However limitations towards practical implementations have also been mentioned.

4- Active wake excitation achieved through move of control surfaces or use of control jets have been presented from experimental studies. The approach can be used in combination with chosen span loading configurations to further optimize given wake alleviation principles.

Conclusions:

Open Issues:

- Effect of vortex core size for wake alleviation
- Validation of vortex stability theories at realistic Reynolds numbers
- Translation of the current understanding to a real aircraft is not fully developed yet
- Vortex control devices: what do they really do, how to make them efficient, practical & robust?

Future:

- Must consider applicability and proof of concept
- Need to understand the effect of control devices on efficiency of wing design
- Need to start thinking about applicability of some of the concepts and their viability on actual aircraft