MINUTES of the
3rd WakeNet3-Europe Major Workshop
on
Developments in Wake Turbulence Safety

Southampton (De Vere Grand Harbour Hotel), UK
May 10th & 11th 2011

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Disclaimer:

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1. Executive Summary

- The third major WakeNet3-Europe Workshop was held in Southampton, UK, on Tuesday, May 10th and Wednesday, May 11th, 2011, at the De Vere Grand Harbour Hotel.
- Approximately 50 participants attended the workshop from Europe, Japan, China and the USA.
- In total, 17 presentations were given in the three main workshop sessions.

2. Final Agenda – Day 1 – May 10th, 2011

09:00	**Workshop Registration**
09:30	**Welcome & Introduction** PAUL HASKINS, GM LONDON TERMINAL CONTROL, NATS DIETRICH KNÖRZER, Scientific Officer, European Commission ANDREAS REINKE, Coordinator - WakeNet3-Europe, AIRBUS
10:00	**Session 1: Wake Turbulence Separations and Recategorisation**
10:00	**Procedural Time Based Separation** JENNI SYKES (NATS)
10:30	**RECAT** DAVID BOOTH (EUROCONTROL)
11:00	**Coffee Break** *(30min)*
11:30	**SESAR project 6.8.1 "Flexible and Dynamic Use of Wake Vortex Separations"** MIKE COWHAM (NATS)
12:00	**Airport Terminal Traffic Simulation Applying Reduced Wake Vortex Separation** NAOKI MATAYOSHI (JAXA)
12:30	**Lunch** *(1:30min)*
14:00	**Update on A380 Wake Vortex Activities** CLAUDE LELAIE (AIRBUS)
14:30	**Investigating Technology Enablers for Optimised Wake Vortex Separation** SHANNA SCHOENHALS (TU-BRAUNSCHWEIG)
15:00	**Coffee Break** *(30min)*
15:30	**CROPS/TBS** DAVID BOOTH (EUROCONTROL)
16:00	**SESAR project 12.2.2 "Runway Wake Vortex Detection, Prediction and Decision Support Tools"** JEAN-FRANCOIS MONEUSE (THALES AIR SYSTEMS)
16:30	**End of Day 1**

3. Final Agenda – Day 2 – May 11th, 2011

08:45	**Workshop Opening**
09:00	**Session 2 : Continued Wake Vortex Research**
09:00	**A theoretical explanation as to why the induced rolling moment of an A380 wake on an A320 or A300 aircraft can be much like that of a B747 wake** GREGOIRE WINCKELMANS (UCL)
09:30	**Wake Vortex Topology and Decay – New Insights from Observation and Simulation** FRANK HOLZAEPFEL (DLR)
10:00	**Coffee Break** *(30min)*
10:30	**Wake Vortex Scattering Characteristics and Future Research Needs** XUESONG WANG (NUDT) PRESENTED BY ZHONGXUN LIU (NUDT/ISAE)
11:00	**Session 3 : Wake Advisory Systems & Weather Prediction**
11:00	**Towards a Wake Encounter Advisory & Avoidance System – Recent work at DLR** TOBIAS BAUER (DLR)
11:30	**Benefits of Conditional Reduction of Wake Turbulence Separation Minima** JENS KONOPKA (DFS)
12:00	**Lunch** *(1:30min)*
13:15	**SESAR projects 9.11 & 9.30 "Aircraft Systems for Wake Encounter Alleviation"** SEBASTIAN KAUERTZ (AIRBUS)
13:45	**Wind and Wake Vortex Monitoring Sensors Research Needs for Airport Operations** FREDERIC BARBARESCO (THALES AIR SYSTEMS)
14:15	**WN3E Workshop Comments** DIETRICH KNÖRZER (EC), ANDREW BADHAM (UK CAA), BOB LUNNON (UK MET OFFICE), ANDREAS REINKE (AIRBUS)
14:45	**Coffee Break** *(15min)*
15:00	**A Radar Simulator for Monitoring Wake Turbulence in Rainy Weather** ZHONGXUN LIU (NUDT/ISAE)
15:30	**GreenWake** CARSTEN SCHWARZ (DLR)
16:00	**Closing Session**
16:00	**Workshop Close** ANDREAS REINKE (AIRBUS), MATT ROSS (NATS), OTHERS
16:30	**End of Workshop**

4. Workshop Presentations and Q & A

Welcome & Introduction

Paul HASKINS, General Manager London Terminal Control, NATS

Paul HASKINS welcomes all participants to the Workshop in his function of local host to the workshop. Mr Haskins gave details of his involvement within NERL, highlighted the issues at London Heathrow to demonstrate why wake turbulence research and these forums are so important. Mr Haskins expressed his thanks for all those that had travelled to attend the event and wished everyone a successful workshop.

Dietrich KNÖRZER, Scientific Officer, European Commission

Dietrich KNÖRZER also welcomed all participants in his function as representative of the funding organisation, the European Commission (EC). Mr Knörzer's presentation addressed the following:

- Policy issues on European RTD and the fact that EU R&D investment is lagging behind the main competitors.
- FP7 overall budget breakdown (8% for Transport including Aeronautics) and the funding of specific Aeronautics research on an EU level.
- European Aviation Vision 2050 which include highly ambitious goals which have been categorised into 'Maintaining global leadership' and 'Serving society's needs'.
- Within FP7 there are six calls for proposals within Aeronautics and Air Transport. The 5th and 6th calls are planned to be launched within the next two years.
- The Evaluation criteria applicable to collaborative FP7 project proposals.

Andreas REINKE, Coordinator - WakeNet3-Europe, Airbus

Andreas REINKE welcomed all participants and introduced them to the WakeNet3-Europe Coordination Action project which is funded by the European Commission within the 7th framework programme and includes 13 beneficiaries plus Eurocontrol as Third Party. This workshop is the third of four major workshops planned within WakeNet3-Europe. Mr Reinke also provided details of the upcoming events planned within WakeNet3 including the specific workshops due to take place in 2011.

SESSION 1 – Wake Turbulence Separations and Recategorisation

Procedural Time Based Separation
Jennifer SYKES / NATS

Procedural Time Based Separation has been re-named within NATS to Reduced Final Approach Separation (RFAS). An update of the research progress within the RFAS project and the resulting evolution of the concept is provided. The concept looks to reduce the final approach separation by 0.5nm for selected wake constrained arrival pairs (>3nm separation requirements) at Heathrow during selected weather conditions. Wake encounter mitigation is requested for all stages of approach where the reduced separations are to be applicable. The project is at an early stage, and work is preliminary therefore subject to change as research continues. Currently considered weather criteria to aid wake encounter mitigation include 10kt ground level headwind components or 6kt ground level crosswind components, in addition to average headwind components on the glideslope of around 20kts. A

crosswind component at altitudes associated with aircraft on the localiser (but not glidepath) may be required to aid lateral transport of wake vortices. Mitigations at regions associated with turn-on to the localiser are currently unknown and advice is sought from the audience. A further challenge to the project is the request for an absolute rather than relative safety assurance, and the author requests guidance as to how this may be achieved (if at all).

Comments, Questions & Answers:

Q (*Konopka*): The requirement is for an absolute safety assessment, but the work involved is for a relative safety assessment?
A: The analysis is a comparative safety assessment and we are looking to adapt our methods to take an absolute assessment into account. This is difficult so we are looking to get input from those attending this workshop.

Q (*Winckelmans*): What is the real requirement? 10-20kts, I'm surprised this requirement is not better defined.
A: Average 20kts headwind component from around 4DME – there may be a graduation between 4DME and the ground. Wake modelling has not started yet and is planned to refine this and other requirements.

Q (*Fisher*): 20kts on the glidepath? When this concept was discussed during the Specific workshop at Heathrow in February 2011 it was noted that it would be for all wind conditions.
A: 20kts is the average winds aloft from 4DME to the top of the glidepath. This is in response to requested wake encounter mitigation for all regions where reduced separations are to be applied and also to roughly maintain time separations against current separations in lighter headwinds. It is a change to the concept.

Q: How is this addressed?
A: A number of methods are being explored including downlinked Mode S information, MET sensors and LiDAR wind measurements.

Q (*Luckner*): P-TBS proposes a reduction of 0.5Nm for certain arrival pairs. How shall this be harmonised with additional separation reductions that may result from RECAT?
A: It's not clear what an ANSP has to do for RECAT to adopt the criteria – for example any additional safety evidence and arguments around practices and procedures. These are important to NATS since we have filed differences relating to the application of the current separation standards. These were approved when we made safety improvements and the introduction of NATS revised categories. It's unlikely that NATS will adopt RECAT I, since indications are that our current operations are similar in performance to RECAT I, but are mature having had many years of measured operational performance.

Q: You mention the concept is restricted to selected pairs, but then it looks like the concept applies to all wake constrained pairs?
A: We are currently considering all wake constrained pairs with separations of 4nm or greater. We also anticipate that the initial implementation may only be applied to certain pairings. Larger separations such as 7 or 8nm may be conceptually harder for ATCOs, so may look to restrict certain pairs.

RECAT
David BOOTH / EUROCONTROL

RECAT is a joint EUROCONTROL and FAA project which aims to re-categorise the current ICAO wake turbulence separation minima for aircraft on final approach and during departure. The RECAT concept is subdivided into three phases, the first involved investigating the subdivision of existing wake categories and the objective of the third phase is to lead towards dynamic pair-wise separations. This presentation focuses on the current Phase 1 activities where the Methodology and Safety Case

documentation was distributed in March 2011 and the project team are currently addressing comments from the stakeholder review. The presentation also provided details of the activities which will be taking place within Phase 2 of the project and the expected benefits.

Comments, Questions & Answers:

Q (*Reinke*): Are the RECAT documents available for the public? Could WakeNet help?
A: The documentation is not public at the moment. It has been sent to all involved parties in RECAT and we are currently addressing the comments before taking it to the ICAO Wake Turbulence Study Group. I will take back the offer of help with the review of the documentation from the WakeNet3 consortium to my colleagues, at least in terms of providing additional comments.

Q: What methodology will be used for future aircraft types?
A: The aim is to put future aircraft into groups under RECAT Phase 1, using the aircraft as a generator and a follower. The methodology is therefore flexible to assess new aircraft.

Q (*Morris):* If circulation is impacted by speed, what assumptions have been made?
A: At present time the assumption is the average approach speed for each generic aircraft type. For the A380 we have assumed 155kts.

Q (*Fisher):* What has been done for the follower aircraft?
A: For Phase 1, circulation has been used. When reducing separation between Heavy-Heavy aircraft pairs the percentage of control authority has been used to increase the separation for the smallest. For Phase 2 it has not been decided yet and there is large room for discussion.

Q (*Konopka):* What is the anchor/pairing that given separation should be?
A: Always take the worst case scenario, heaviest in the first category and lightest in the second category as a baseline.

SESAR WP6.8.1 – "Flexible and Dynamic Use of Wake Vortex Separations"
Mike COWHAM / NATS

SESAR P681 Phase 1 will validate the rule changes, tools and procedures required to deliver Time Based Separation into approach operations. This presentation focuses on the controller tool support requirements and reflects on the findings from the NATS internal Time Based Separation real time simulation run in October 2010. In order for approach controllers to deliver aircraft to Time Based Separation it will be necessary to display a 'separation indicator' on the radar display. Approach controllers will be responsible for maintaining radar separation with respect to this indicator. A key conclusion that emerged was that the position of this indicator relative to the lead aircraft should not change; controllers cannot deliver against a moving separation target. The implications of this decision on the likely safety evidence required to validate are discussed; it cannot be assumed that aircraft will maintain a constant time spacing on final approach.

Comments, Questions & Answers:

Q (*Fisher*): What winds did you simulate?

A: A wind profile that changed in strength and direction with altitude. Some profiles that also changed with time. Typically stronger headwind profiles, light winds will be considered in the October 2011 simulation.

Q (*Konopka*): Will the time separation be predicted based on groundspeed to 4DME or at 4DME?

A: Depends what you choose as a reference, if it was 90 seconds between two Heavy aircraft then would need to know the average predicted groundspeed from now to 4DME.

Q (*Konopka*): Correct separation for a given pair is needed; this information from Mode S or flight plan is subject to an error of maybe 1%?

A: The future concept is expected to be implemented after EFD so there should be good aircraft type information. There is the assumption that the aircraft type shown is correct.

Q: Have you looked into the results for tailwinds?

A: No, but this will likely be investigated in the future.

Airport Terminal Traffic Simulation Applying Reduced Wake Vortex Separation
Naoki MATAYOSHI / JAXA

JAXA has developed an airport terminal traffic simulation environment that probabilistically evaluates wake vortex encounter risk and dynamically minimizes aircraft wake vortex separation. The author proposes a calculation method of acceptable encounter risk level considering various weather conditions and quantitatively shows the impact of weather information errors on wake vortex separation reduction.

Comments, Questions & Answers:

Q (*Konopka*): In your approach are you not increasing the average risk?

A: The assumption is that the current wake vortex separations are safe therefore this approach is still safe.

Update on A380 Wake Vortex Activities
Claude LELAIE / Airbus

Abstract Missing – Please see WakeNet3-Europe Website for Presentation Slides

Comments, Questions & Answers:

(*Blue*): Wake vortices are generated weaker in ground effect due to the interaction with the ground. There has been lots of good research conducted on in ground effect.
(*Desenfans*): The more risky area is not in ground, but near ground effect, 1-2 wingspans.
(*Luckner*): If an aircraft comes closer to the ground, the danger from the vortex is reduced (due to the stronger decay in Ground effect), but there is also a reduction of the amount of vortex-induced disturbance that a pilot accepts.
(*Holzaepfel*): The question is not fully answered, we have seen in the NATS data that close to the ground there are circulations that are very high, several hundred m/s.

Investigating Technology Enablers for Optimised Wake Vortex Separation
Shanna SCHOENHALS / TU-BS

The concept and status of the Ground Based Augmentation System (GBAS) as well as GBAS-defined approach procedures that can potentially be used to conduct optimised wake vortex separations were introduced. The approach currently investigated at TUBS is to use GBAS-defined displaced threshold and varied angle approaches and dynamically optimise aircraft separations by speed variation on the approach path. Encounter safety shall be assured by appropriate wake prediction and detection means. First implementation results show that separation reduction is feasible with this approach, yet further research and integration is necessary for concept maturity.

Comments, Questions & Answers:

Q (*Morris*): Who is responsible for the separation, the pilot or the controller?

A: For what has been investigated the flight deck, for final separation the whole system.

Q (*Morris*): The results presented applied to a single aircraft pair. What would be the effect for an aircraft sequence as they appear in the real operational environment?

A: This effect has not yet been investigated, and it would be the next step in order to assess the concept's benefits. It shall be once more stressed that integration with ATC tactical planning tools is highly desirable for the concept to provide maximum benefits.

Q: If you are continually putting aircraft on the glide path, what is the separation at start of final approach?

A: It is not really important for the end application. There is a need to integrate the system with a more complex and integrated planning tool in order to plan how to optimise the sequencing and separation at the beginning of the procedure would work. This would be interesting to investigate, but is not in the current scope of the study.

Q (*van der Geest*): Could these approaches not also be realised with SBAS (Space Based Augmentation System which is already operational and in some parts of the world already certified for use in air navigation)?

A: In principle, the use of any performance based approach operations can be thought of in order to optimise wake separation as was presented for this concept. However, the advantage of GBAS lies on the one hand in the high trust level for the integrity information it provides, on the other hand, any approach information and parameters are provided by the local station and thus only need to be certified once. For SBAS approaches, the certification process would be transferred to the onboard database level and would cause much higher costs for the manufacturer and end user (e.g. for certification and maintenance).

CROPS/TBS-TS
David BOOTH / EUROCONTROL

The objective of the CROPS/TBS-TS project is to implement a procedural change only to authorise a 0.5Nm reduction of wake turbulence distance based separation between WT pairs on final approach. The application of this procedure will only be in specific headwind/crosswind conditions. This presentation described aspects of the safety assessment including the conditions required for CROPS to be implemented, the key assumptions and limitations of the concept and the local ATM characteristics which would need to be considered.

Comments, Questions & Answers:

Q (*Lelaie*): The action to eliminate/reduce wind – with wind reducing capacity of airports. Should there be something in RECAT which should be powerful to increase the capacity?
A: When crosswind was first investigated we looked at a 0.5, 1 Nm reduction as it is good to have standardised approach. For speed we have said 0.5Nm reduction for crosswind and headwind – then more work may prove further reduction is possible – could go to min radar sep. The intention for RECAT is for separation for all wind conditions, as current ICAO separation used today.

Q (*Lelaie*): In Europe/USA you can implement specific rules. Could 25kts be a good start?
A: Something to consider; this is definitely not a closed view.

Q (*Konopka*): Previous findings in the 1970s suggested around a 10kts headwind, 6kts crosswind. Still the most critical question to answer is how does an airport/local ANSP know that the conditions persist?
A: We have proposed some guidelines – for example for procedure to come into effect conditions have to have been there for 20 minutes and forecasted for at least 30 minutes. The departure will depend on the capability of the ANSP and will be there decision to make.

Q: What is the danger of an encounter? In Europe there is a database of 1500 encounters in simulators looking at aircraft upset from wake encounters rated by pilots. Are you planning anything with regards to this?

A: This is something that needs to be addressed in the future for the different phases of flights. There is currently no resource at time this time for this to be done in-house – would need to look externally.

(*Lelaie*): The question is can the simulator reproduce these vertical accelerations seen in some wake encounters – No. If it cannot reproduce an encounter as seen in flight then we will draw the wrong conclusions. We need to be sure the simulator can do the same thing as aircraft.

Q (*Morris*): With the crosswind concept, wake is being transported out of the safety corridor. Has anything been assumed regarding the divergence of aircraft from standard departure routes?
A: Departures have not been addressed at the moment. For arrivals it is up to the local ANSP; however it must be stated that the concept can only be used when aircraft are established on final approach.

SESAR WP12.2.2 – "Runway Wake Vortex Detection, Prediction and Decision Support Tools"

Jean-Francois MONEUSE / Thales Air Systems

Abstract Missing – Please see WakeNet3-Europe Website for Presentation Slides

Comments, Questions & Answers:

Q (*Morris*): With forecast and nowcast integrated into a wind cube there are no downlinked airborne parameters included. Do u think this is important?
A: We looked at the possibility of including Mode S, database of exchange – wind, humidity, using other data. We also are looking into ADS-B data. This kind of information will probably be included in step 2, not step 1.

SESSION 2 – Continued Wake Vortex Research

A Theoretical Explanation as to why the induced rolling moment of an A380 on an A320 or A300 aircraft can be much like that of a B747

Gregoire WINCKELMANS / UCL

Even for complex wing configurations, as typical of aircraft in approach to landing, the vortex wake in the mid to far field , in a neutral atmosphere and before any long wave Crow-type instability develop, is made of a counter-rotating two-vortex system (2VS), which has attained an equilibrium. This canonical turbulent system is then characterized by at least three global parameters: the total circulation, Γ_0, of each vortex, the effective core size, r_c, of each vortex (defined as the location of maximum induced velocity), and the distance, b_0, between the vortex centers. An important ratio is then r_c/b_0: it is determined by the fluid mechanics of the turbulent 2VS itself.

We here consider such 2VS, and for cases as can be expected for A380 and B747 type aircraft. We use a simple and classical $\Gamma(r)$ profile. We then investigate the theoretical (i.e., obtained using a static analysis) rolling moment coefficient, C_R, that such 2VS can induce on medium type follower aircraft, such as A320 and A300, as a function of the span-wise distance to the 2VS. The results show that, even for an assumed 20% higher circulation of the A380 wake compared to that of the B747, the resulting worst C_R levels are only marginally different.

Comments, Questions & Answers:

Wake Vortex Topology and Decay – New insights from Observation and Simulation

Frank HOLZAEPFEL / DLR

Large-eddy simulations of a coherent counter-rotating vortex pair in different environments are performed. The environmental background is characterized by varying turbulence intensities and stable temperature stratifications. Turbulent exchange processes between the vortices, the vortex oval and the environment, as well as the material redistribution processes along the vortex tubes are investigated employing passive tracers that are superimposed to the initial vortex flow field.

Various features of three-dimensional wake vortex evolution are well captured by the series of simulations, i.e., Crow instability, vortex reconnection, propagating helical vorticity structures, vortex ring formation and generation of secondary vorticity structures, vortex bursting and detrainment of passive tracers. It is revealed that the “vortex bursting” phenomenon, known from photos of aircraft contrails or smoke visualization, is caused by collisions of secondary vortex structures traveling along the vortex centerline which dash material out of the vortex but do not result in a sudden decay of circulation. Evidence is provided that these secondary vorticity structures may also generate funnel-shaped vortex core features that are surrounded by vortex bursting structures. The interaction of helical instabilities generated by pressure disturbances from the vortex reconnection process, and the secondary vortex structures results in rapid vortex decay in stably stratified environments. This interaction does not occur under neutrally stratified and weakly turbulent conditions and a long-lived vortex ring may form revealing intriguing effects: the vortex ring links a second time and a short time later the established double rings merge again into a single vortex ring. Evidence of key phenomena observed in the simulations is brought about by photographs of contrails. The vertical and lateral extents of the detrained passive tracer strongly depend on environmental conditions where the sensitivity of detrainment rates on initial tracer distributions within the wake appears low. The degree of stable temperature stratification mainly controls the detrainment rate, while the strength of (generally weak) ambient turbulence affects the onset time of detrainment. Circulation decay and passive tracer detrainment are driven by similar mechanisms and thus are well correlated.

Comments, Questions & Answers:

(*Knörzer*): This gives some encouragement to understanding wake vortex behaviours and a fairly good explanation of what is happening. It could be useful for some of the questions related to the A380.

(*Holzaepfel):* Provided LES data for flight simulations which are much more realistic but complexity increases so it is difficult for final conclusions to be drawn. It could help in real life, incorporating what Airbus have done.

(*Holzaepfel):* Successful results have been achieved using the current concept, but want to progress this further. In the future we will investigate more detailed aircraft flow. Results are not likely to change a great deal but will become more realistic.

Q (*Badham*): Most of the work is concentrated on wingtip vortices. Should we be looking at smaller intense vortices, e.g. off the tail of the aircraft?

A:

(*Reinke*): Looking at future simulations, maybe we should put more effort into core development for checks on circulation.

Wake Vortex Scattering Characteristics and Future Research Needs

Zuesong Wang / NUDT [Presented by Zhongxun Liu]

The study of the radar scattering characteristics is of great necessity to the development of radar detection technology of wake vortices. This presentation proposes a new computation routine for the scattering study, and presents some new findings on the scattering characteristics of wake vortices,

including the characteristics of RCS-Frequency, RCS-time, and HRR profile. At the same time, future research needs on the scattering mechanism and computation routine are discussed.

Comments, Questions & Answers:

SESSION 3 – Wake Advisory Systems & Weather Prediction

Towards a Wake Encounter Advisory & Avoidance System – Recent Work at DLR
Tobias BAUER / DLR

German Aerospace Centre DLR is working on a Wake Encounter Advisory & Avoidance (WEAA) system allowing the avoidance of potentially dangerous wake vortex encounters by a tactical evasion manoeuvre. Such manoeuvre is of small scale i.e. tries to adhere to the planned flight track as closely as possible and is not intended to require ATC permission. Work on the WEAA system is on-going but initial results are presented: the system conceptual design and selected system functions such as wake vortex prediction and hazard evaluation, avoidance trajectory generation, and human machine interface to raise the pilots' situational awareness.

Comments, Questions & Answers:

Q (*Konopka*): It is known that the potential approach will not allow avoidance of the 'target' if velocity of encountering aircraft is sufficiently high.
A: This is true; in fact the slide 14 of the presentation is mislabelled in that it shows a force field (as gradient of the potential) not the potential itself. We can usually obtain sufficient repulsion by lengthening the field in direction of relative velocity as depicted, the dimensions of the field being a matter of fine tuning. It is conceivable that still the repulsive force will not be strong enough in relation to other, more substantial threats e.g. collision and ground avoidance. This is by design so that if a conflict free avoidance trajectory cannot be determined a possible wake vortex encounter will be accepted as the lesser evil. Cautions are issued to the pilots in that case.

Q (*Konopka*): The presentation claims '*most* LiDARs only measure line-of-sight velocities', is this true for *all* LiDARS?
A: There are evaluation methods like Speckle Imaging Velocimetry which can deduct the complete velocity vector correlating return signals in space and time, comparable to PIV measurements. However, these methods are still in early development stages.

Q (*Parker*): How often is the system expected to be triggered in dense airspace?
A: This is a matter also of input parameter uncertainty (position and position prediction of wakes and other traffic) and in fact one of the questions that will be investigated in off-line simulation. While the benefit in a single avoidance situation is obvious the overall operational viability remains to be shown.

Q: Is a limit for an acceptable encounter taken into account in order to avoid unnecessary manoeuvring?
A: Yes, in two ways: wake habitation volumes are truncated below a certain circulation level, and in case of a detected conflict the severity assessment may predict a low encounter severity due to the particular encounter parameters. In that case only an advisory to the pilots is issued.

Q: What is the time horizon for the avoidance manoeuvre?
A: As other traffic intent is not known and wake prediction depends on many changing parameters we aim to keep the time horizon for actual pilot action short. In most flight phases the manoeuvre will require small flight path changes only - a few hundred feet in height or a few hundred metres laterally. Thus small accelarations are sufficient to execute it in a time frame comparable to TCAS (i.e. 30-40 secs).

Benefits of Conditional Reduction of Wake Turbulence Separation Minima
Jens KONOPKA / DFS

Many of the concepts to adapt wake turbulence separation minima provide room for additional take-offs or landings only if certain conditions are given. During periods when such conditions prevail - mostly of meteorological nature, e.g. (cross)windspeed exceeding certain limits - wake turbulence separations could potentially be reduced. This can either be used to reduce delay or cater for a few more departures or landings. However a translation into more airport slots will result in amplified delay problems during those periods when these favourable meteorological conditions are not given. The presentation briefly explains the relation between (scheduled) airport capacity and delay and how capacity can be determined. Using examples it is illustrated, how the potential benefits of promising wake concepts diminish when being confronted with observed weather data.

Comments, Questions & Answers:

SESAR WP9.11 & 9.30 – "Aircraft Systems for Wake Encounter Alleviation"
Sebastian KAUERTZ / Airbus

SESAR projects 9.11 and 9.30 dealing with "Aircraft Systems for Wake Encounter Alleviation" are now in execution for about one year. The presentation shows first project results and reports on the activities performed in the projects so far. A demonstrator available from the FLYSAFE project has been tested during Airbus wake vortex encounter flight test campaigns in Nov. 2010. The definition of the operational concept and detailed architecture of the systems as well as improvement of several technical sub-functions are the major activities ongoing at the moment.

Comments, Questions & Answers:

Q: Do you consider you might run out of bandwidth on the data link?
A: The envisaged data link would be ADS-B, which contains already most of the required data; only a few parameters would have to be added. In any case an existing data link will be used, not a new one specific to the system.

Q: From the schematics the system looks similar to TCAS. Can you imagine this system to be combined with TCAS?
A: It will probably be even more challenging to get the system operational in combination with TCAS. But interaction with TCAS, and also other warning systems like ground proximity or weather, will be considered by the project.

Q: When is it planned to become operational?
A: TRL6 (end of R&T) is planned in 2016, so probably not operational before 2020.

Wind and Wake Vortex Monitoring Sensors Research Needs for Airport Operations
Frederic BARBARESCO / Thales Air Systems

Abstract Missing – Please see WakeNet3-Europe Website for Presentation Slides

Comments, Questions & Answers:

A Radar Simulator for Monitoring Wake Turbulence in Rainy Weather
Zhongxun LIU / NUDT/ISAE

A radar simulator has been developed for monitoring wake vortices in rainy weather. The motion equation of raindrops within wake vortices is numerically solved, and the instantaneous position and velocity of raindrops are obtained. The radar echo model is established for the observation of raindrops within wake vortices. Simulation results of X band radar illustrate the extended Doppler spectrum of raindrops which may be applicable for identifying wake vortex hazard in rainy weather for aviation safety.

Comments, Questions & Answers:

Update on Green-Wake project
Carsten SCHWARZ / DLR

Green-Wake project overview (European FP7 project "UV Lidar for Wake Vortex Detection", http://www.greenwake.org) and update on the latest project status. The Green-Wake project will develop and test an on-board short-range (50-100m) Imaging Doppler LIDAR system that is capable of detecting and measuring wake vortices and wind shear phenomena in front of an aircraft. The aim of the project is to develop a system suitable for integration into a commercial aircraft, but also to look at how data is to be supplied to the aircrew most effectively.

Comments, Questions & Answers:

One question was regarding the planned wind tunnel tests for wake vortex measurements. LH and CS explained that a slightly modified prototype will be used and that the purpose of the wind tunnel tests is basically to conduct a first phase of testing with the prototype in a defined environment before measuring real wakes.

Another question was regarding the time for warning the pilots. CS explained that the main idea with the Green-Wake measurement range is to provide automatic flight control commands but that additionally there should be a warning to increase situational awareness.

MW questioned whether the wake vortex flight control actions would override the pilot inputs. CS explained that the wake alleviation control commands could be added to the pilot inputs, similar to the Airbus "normal law" working in the "background" with the pilot in command.

AF commented that he is still much in favour of the idea of providing measured information to the pilots, rather than only using wake prediction models.

5. Workshop Participants

Group photo

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