Workshop has been scheduled for
Jan 2 (3pm-6 pm)
Jan 3 (8am-6pm)

Not on the
AIAA website yet

Telecon agenda, June 11, 2015

- Review May telecon notes
- Administrivia
  - Website
  - Updated analysts list
- Analysis results
  - Marcello Righi, Case 1
  - Daniella Raveh
- SciTech discussion/panel (as time allows, or defer to July telecom)

- Next telecon **July 2, 11 a.m.**

May telecon summary

- Held on May 7, 2015 11 a.m.
- Next telecon June 11, 11 a.m. East Coast time in U.S.
- Discussed administrative matters
  - AIAA coordination: Workshop will be held Saturday Jan 2 (3pm-6pm) & Sunday Jan 3 (8am-6pm)
  - Workshop process
  - Workshop agenda
  - Discussed having a panel / discussion session at SciTech- during the conference week
  - Analysis team matrix updates continue
  - Suggested face to face at AIAA Aviation conference- not a lot of anticipated participation
- Corrected & updated workshop information from May
  - Units on stiffness values
    - Kh = 2637 lb/ft = 219.75 lb/in = **219.75 slinch/sec^2**
    - Ktheta = 2964 ft-lb/rad = 35568 in-lb/rad= **35568 slinch-in^2/s^2/rad**
  - Corrected Reynolds number for Case 1 (Mach 0.7, 3°)
    - **Rec = 4.56×10^6; Re = 3.456×10^6**

Important Dates

- Computational Results Submitted by **Nov 15, 2015**
- Workshop: SciTech 2016: **Jan 2-3, 2016**

- Computational Team Telecons: 1st Thursday of every calendar month 11 a.m. EST

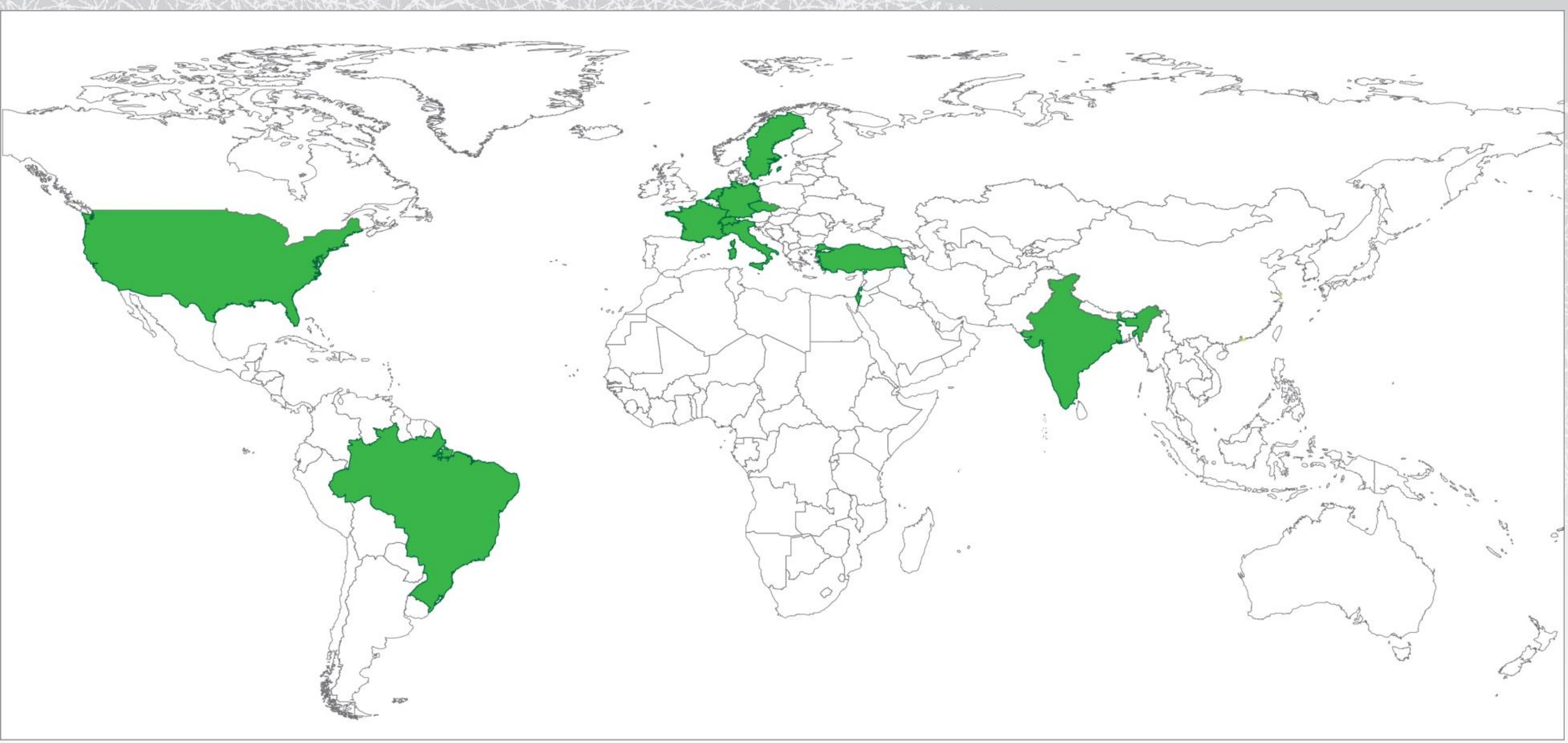
Website notes

- Working to add telecon slides to website

AePW-2 Analyses/Commitments to date (5/29/2015)

Analysis Team	Code	POCs	Email contact
Technion - IIT	EZNSS	Daniella Raveh	daniella@technion.ac.il
FOI	EDGE	Adam Jirasek, Mats Dalenbring	adam.jirasek@gmail.com
NASA	SU2	Dave Schuster	David.m.Schuster@nasa.gov
NASA	FUN3D	Pawel Chwalowski, Jennifer Heeg	Pawel.Chwalowski@nasa.gov, Jennifer.heeg@nasa.gov
Brno University of Technology, Institute of Aerospace Engineering Czech Republic	EDGE	Jan Navratil	navratil@fme.vutbr.cz
NLR		Bimo Pranata	bimo.prananta@nlr.nl
NLR	NASTRAN	Bimo Pranata	bimo.prananta@nlr.nl
Indian Institute of Science	FLUENT	kartik venkatraman	kartik@aero.iisc.ernet.in
Istanbul Technical University	SU2	Melike Nikbay	'nikbay@itu.edu.tr
ATA Engineering	LowPsiChem	Eric Blades	eric.blades@ata-e.com
Embraer S.A.	CFD++,ZTRAN , NASTRAN *	Guilherme Ribeiro Begnini	guilherme.benini@embraer.com.br
Politechnico di Milano	Various codes	Sergio Ricci	sergio.ricci@polimi.it
AFRL	FUN3D	Rick Graves	Rick.Graves@us.af.mil
Mississippi State	MAST	Manav Bhatia	Bhatia@ae.msstate.edu
Zurich University of Applied Sciences (ZHAW, ZUAS)	EDGE, SU2	Marcello Righi	rigm@zhaw.ch
General Atomics Aeronautical Systems	FLUENT/ANSYS	Askar Konkachbaev	askar.konkachbaev@ga.com
ANSYS	ANSYS Fluent, ANSYS CFX, ANSYS Mechanical	Balasubramanyam Sasanapuri (Krishna Zore, Thorsten Hansen, Michael Tooley, Eric Bish)	balasubramanyam.sasanapuri@ansys.com
University of Strasbourg		Yannick Hoarau (Jan Vos)	Hoarau hoarau@unistra.fr

Analysis team map



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Analysis results

Marcello Righi [rigm@zhaw.ch]

Zurich University of Applied Sciences (ZHAW, ZUAS)

Case 1, settings:

- Solver: Edge and SU2; main difference is implicit Euler instead of RK3 in subiterations;
- Grids: coarse (SU2) and medium (Edge);
- Transition: fixed at 7% chord (Edge), turbulent boundary layer from LE (SU2);
- Turbulence model: k-ω EARSM (Edge), SA (SU2);
- Time step $\Delta t = 0.001 - 0.0001$, $\Delta\tau = \frac{\Delta t 2 v}{c} \simeq 0.50 - 0.05$ (reduced time) (Edge), $\Delta t = 0.001\ s$ (SU2);
- Simulation total run time: 10 revolutions;
- Scheme: JST with "usual" artificial dissipation coefficients (0.50, 0.02), both solvers, simulations with Roe's scheme (Edge) did not show anything much different;

Case 1, findings:

- Acceptable agreement between measured and calculated steady state flow, this is shown in Fig. 1;
- Good agreement of first harmonic (both magnitude and phase) but only outside of the shock region, Figs. 2 and 3;
- Very high value of second, third and fourth harmonics in the shock region, Fig. 4;
- Comp. time (Edge): about 1 revolution in one hour (clock time) on 64 cores;
- Results seem to be rather insensitive to scheme, time step, for instance in Figs. 5 and 6.

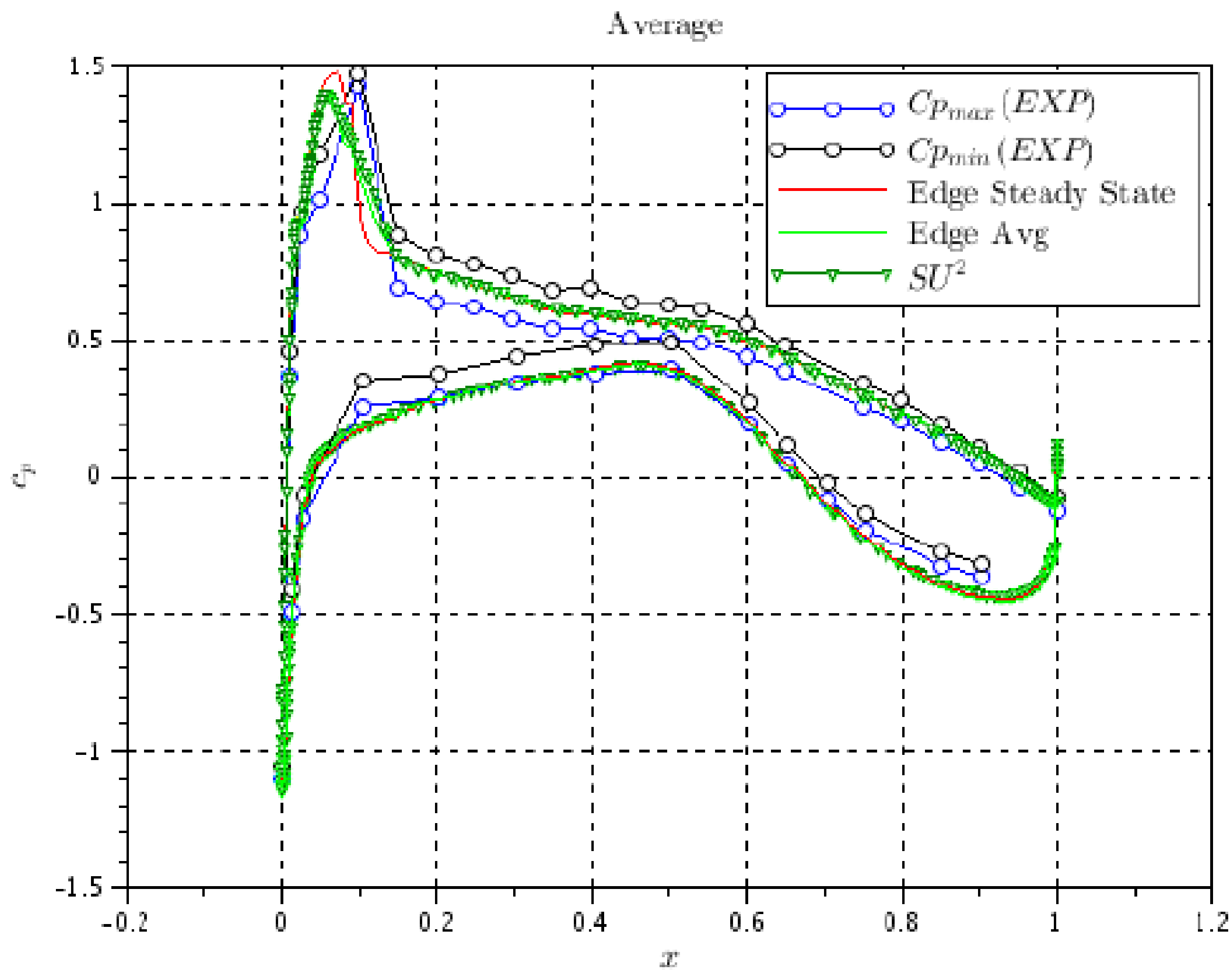
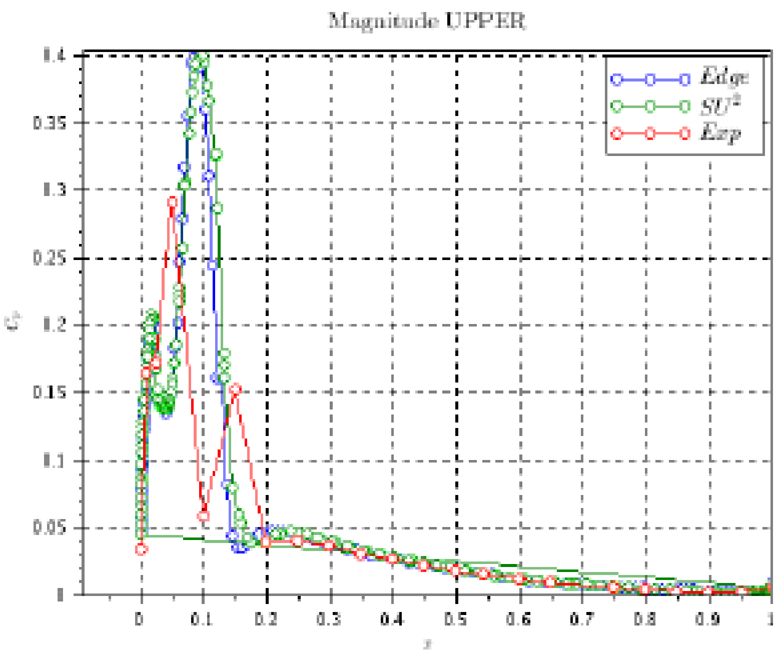


Figure 1: Steady state solution



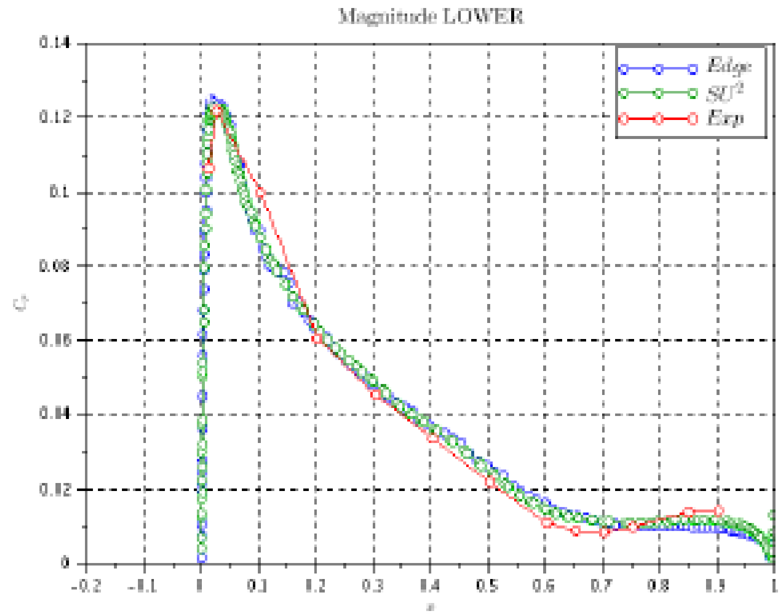
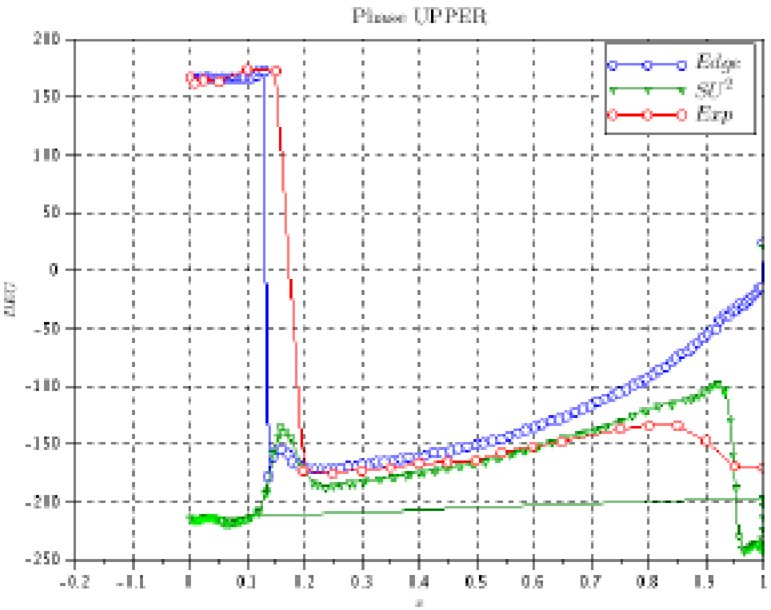


Figure 2: Magnitude, first harmonic



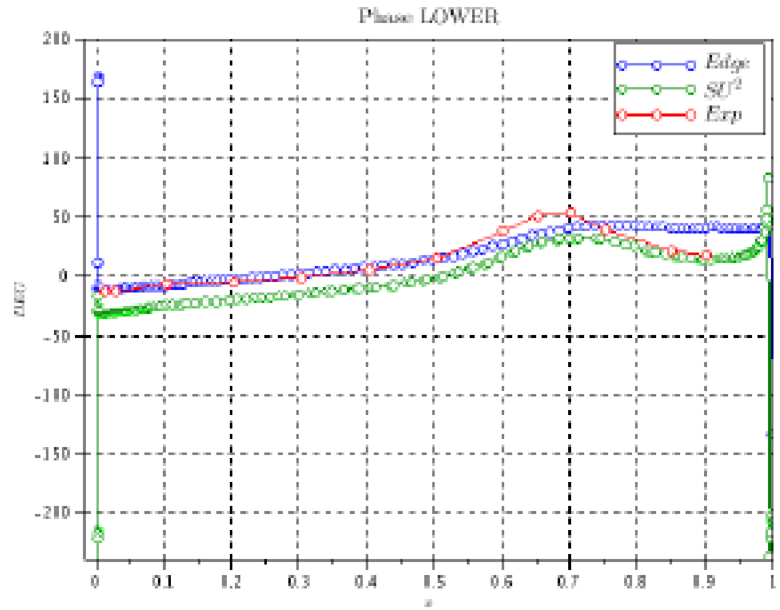


Figure 3: Phase, first harmonic

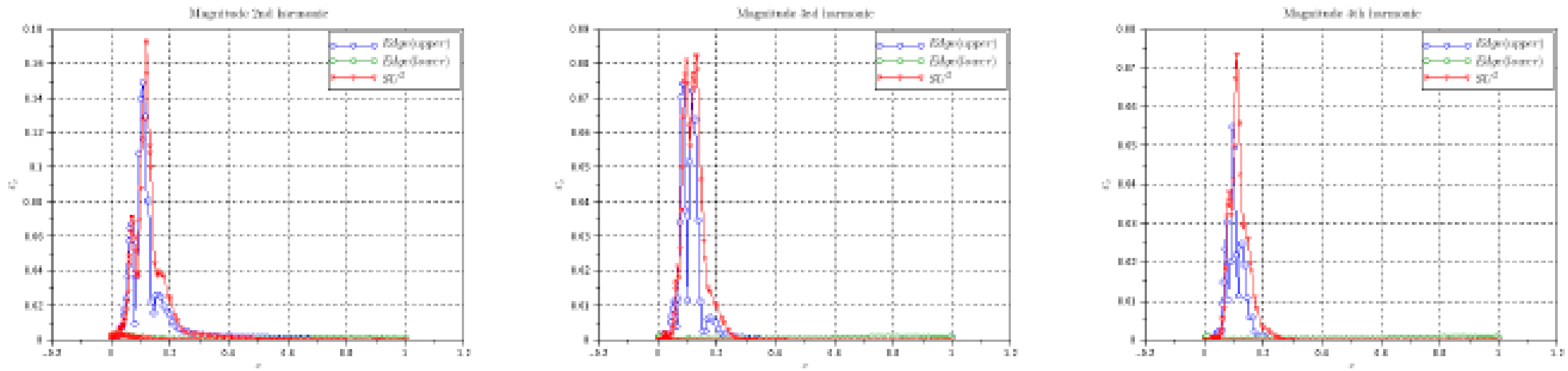


Figure 4: Magnitude, higher harmonics

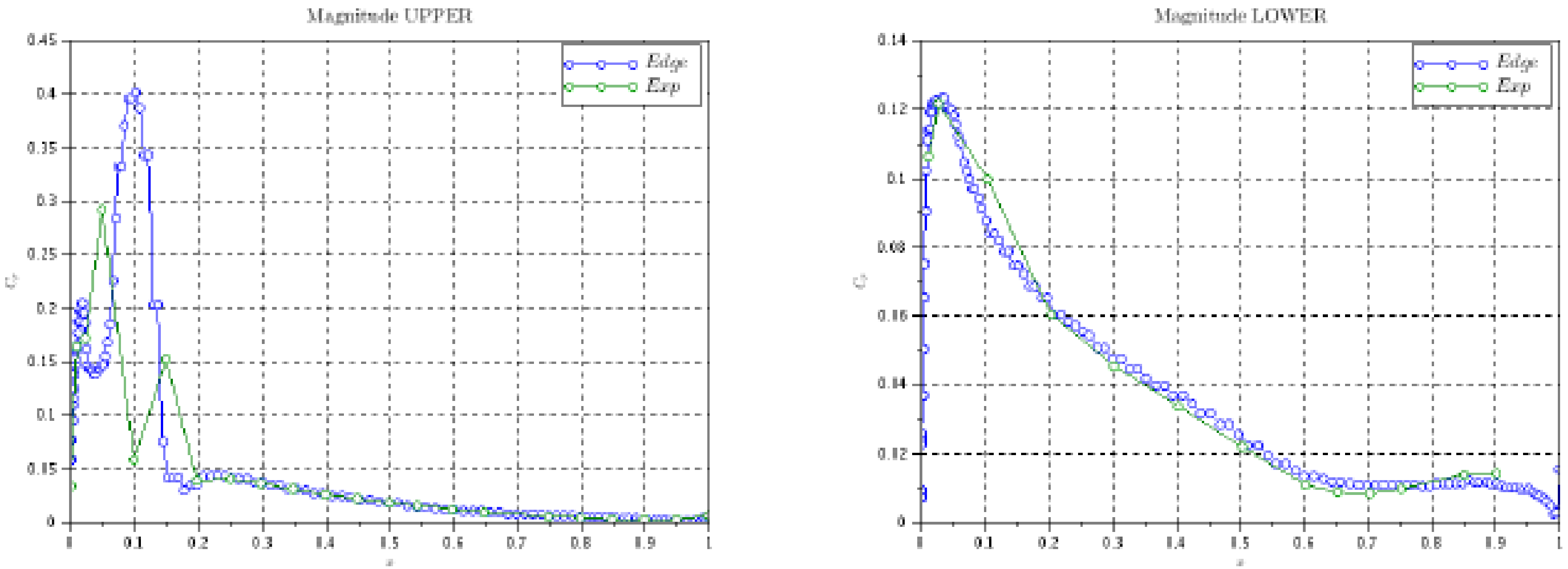


Figure 5: Magnitude, first harmonic, Edge on coarse grid

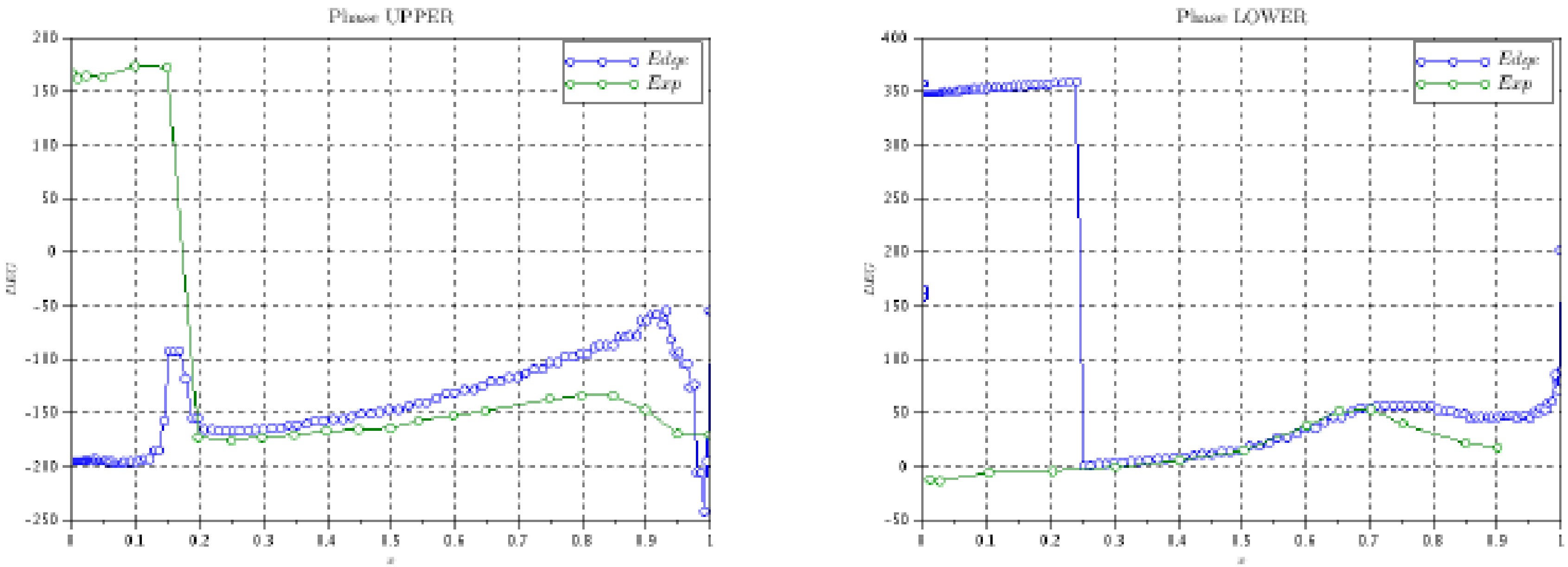
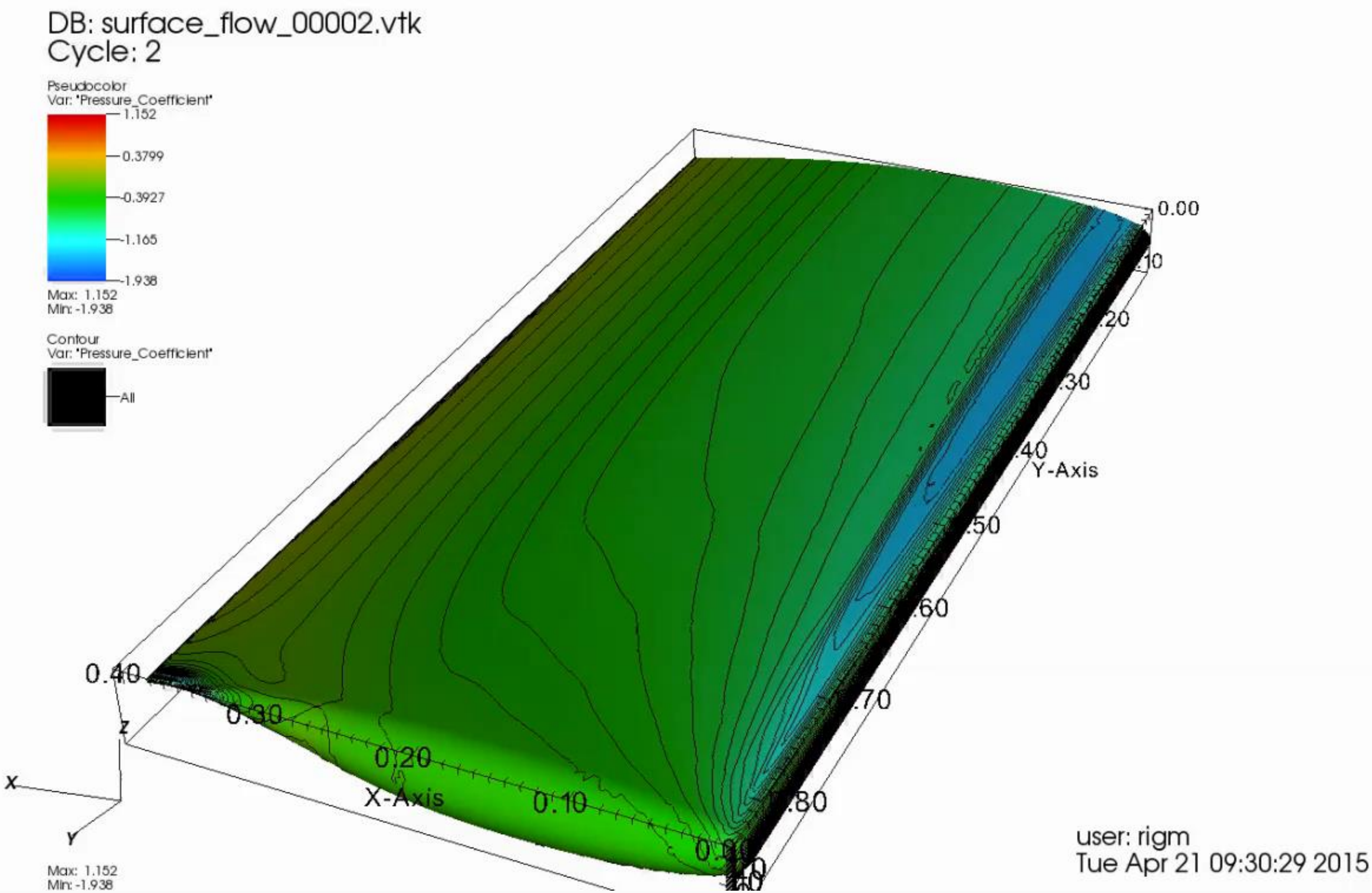


Figure 6: Phase, first harmonic, Edge on coarse grid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Cycle: 2
Pseudocolor
Var: 'Pressure_Coefficient'
1.152
0.3799
-0.3927
-1.165
-1.938
Max: 1.152
Min: -1.938
Contour
Var: 'Pressure_Coefficient'
All
0.00
Y-Axis
X-Axis
0.40
0.30
0.20
0.10
Z
X
Y
Max: 1.152
Min: -1.938
user: rigm
Tue Apr 21 09:30:29 2015

Daniella's slides go here

OpenFOAM mesh converter

Telecon agenda, June 11, 2015

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Envisioned Workshop Process for Analysis Teams (June, 2015)

- Perform analyses
- Submit results
- Prepare informal presentations for workshop
- SciTech 2016
  - AePW-2
    - Present results
    - Results comparisons
    - Discussion of results
    - Path forward
  - **Panel discussion being planned through AIAA SDTC (Bruce Willis, Daniella Raveh) & conference organizers (Joe Slater, John Kosmatka)**
- Re-analyze
- Publish at special sessions of conferences (which conferences?)
- Publish combined journal articles

Rough plan

- Submitted abstract as a place holder
- Communicating with conference organizers regarding how they would like to fit it into the conference
- 1 hour time slot during a conference session requested
- Session, date and time yet to be determined

- Requesting participation on the panel by analysis team members

- Contents of proposed session contained in next few slides

Abstract of Panel discussion

The 2nd AIAA Aeroelastic Prediction Workshop (AePW-2) will be held January 2-3, 2016. The workshop is designed to assess the state of the art of computational methods for predicting unsteady flow fields and aeroelastic response. The Benchmark Supercritical Wing (BSCW) is the subject configuration, analyzed for flutter, forced oscillation response and static aeroelastic behavior. ***The intention of this forum will be to inform the technical community at large of the workshop findings and provide an opportunity for insights and interpretations from individuals working in fields adjacent to aeroelasticity. The panel members will present a summary of the workshop test cases and workshop results. An open discussion of the results, process and path forward will be the heart of this forum.***

Overview of Panel Discussion

- Introduction of the workshop
- Presentation of workshop results
- Open discussion

Part 1: Introduction to the Workshop

The introduction to the workshop will include a brief review of the workshop configuration, analysis cases and experimental data.

10 minute review of:

- *Objectives & Approach*
- *Configuration*
- *Test cases*

Part 2: Presentation of Workshop Results

Show the audience the comparisons among different computational results, as well as comparisons with the experimental data sets.

Analysis team members discuss and present convergence studies and implications on aeroelastic stability and integrated properties.

Rough plan of action?

Willing analysis team collaborate to show results and discuss what they think is going on, what is important, what they have learned, what they think should be done to address open questions, etc

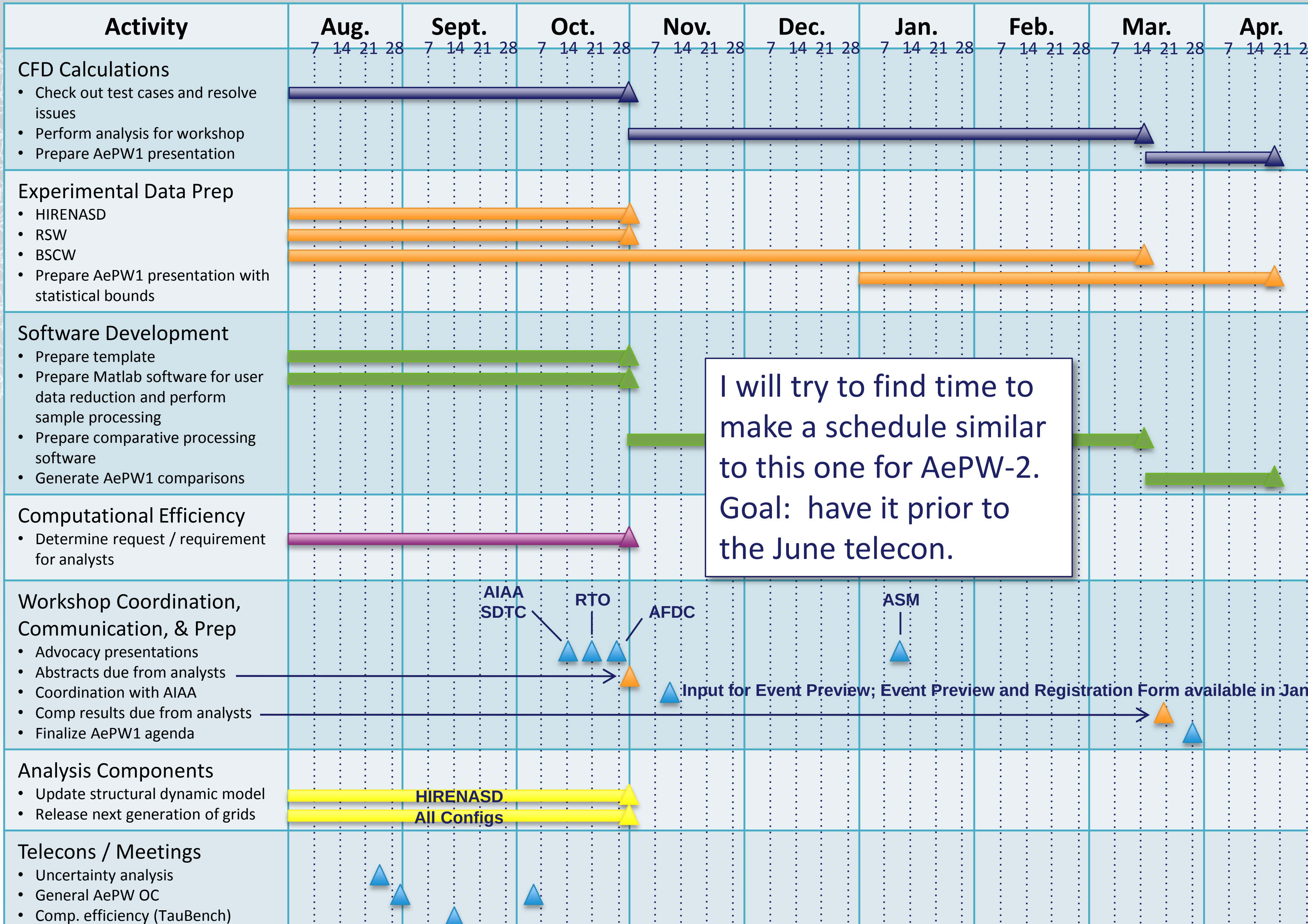
Part 3

The third aspect of the panel will center on interpreting the results, defining re-analysis opportunities and planning the path forward.

A summary of the discussion of these aspects from the workshop will be presented to serve as a springboard for the community at large to offer their insights.

General material and prior telecon summaries

AePW1 Prep Schedule: August 2011 – April 2012



Updated analysis parameter table

Table 1. BSCW analysis input parameters forAePW-2, updated May 4, 2015.

Parameter	Symbol	Units	OTT Configuration	PAPA Configuration	OTT Configuration
Mach	M		0.7	0.74	0.85
AoA	α	deg	$3°$	$0°$	$5°$
Reynolds number (based on chord)	Re_c		$4.560\text{x}10^6$	$4.450\text{x}10^6$	$4.491\text{x}10^6$
Reynolds number per unit length	Re	Re_c/ft	$3.456\text{x}10^6$	$3.338\text{x}10^6$	$3.368\text{x}10^6$
Dynamic pressure	q	psf	170.965	168.800	204.197
Velocity	V	ft/s	387.332	375.700	468.983
Speed of sound	a	ft/s	553.332	506.330	552.933
Static temperature	T_{stat}	F	85.692	89.250	87.913
Density	ρ	$slug/ft^3$	0.00228	0.002392	0.001857
Ratio of specific heats	γ		1.113	1.136	1.116
Dynamic viscosity	μ	$slug/ft-s$	$2.58\text{x}10^{-7}$	$2.69\text{x}10^{-7}$	$2.59\text{x}10^{-7}$
Prandtl number	Pr		0.683	0.755	0.674
Test medium			R-134a	R-12	R-134a
Total pressure	H	psf	823.17		757.31
Static pressure	p	psf	629.661		512.120
Purity	X	$\%$	95	95	95
Ref. molecular weight based on 100% purity	M	g/mol	102.03	120.91	102.03
Sutherland's constant	C	R	438.07	452.13	438.07
Reference viscosity	μ_{ref}	$lb-sec/ft^2$	$2.332\text{x}10^{-7}$	$2.330\text{x}10^{-7}$	$2.332\text{x}10^{-7}$
Reference temperature	T_{ref}	R	491.4	491.4	491.4

May telecon summary

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- Next telecon June 11, 11 a.m. East Coast time in U.S.
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  - Workshop process
  - Workshop agenda
  - Discussed having a panel / discussion session at SciTech- during the conference week
  - Analysis team matrix updates continue
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  - Corrected Reynolds number for Case 1 (Mach 0.7, 3°)
    - **Rec = 4.56×10^6; Re = 3.456×10^6**

AIAA Interactions

Approved and signed off by
Bruce Willis, Chairman of Structural Dynamics Technical Committee
Megan Scheidt, Managing Director of Products and Programs

AIAA
Shaping the Future of Aerospace

Agreement for Organizing a Workshop at an AIAA Event

This document outlines the specifications and expectations for organizing a workshop at an AIAA event.

General

- Workshop Name: 2nd AIAA CFD Aeroelastic Prediction Workshop (AePW-2)
- Associated Event: SciTech 2016
- Location: Manchester Grand Hyatt, San Diego, CA
- Dates: 2-3 January 2016 (3-6 pm on 2 Januay, 8 am-6 pm on 3 January)

Logistics

AIAA will provide the following items for the workshop:

- Meeting Space: AIAA will provide 1 room that accommodates 75 people classroom-style seating
- Audio/visual Equipment: Projector, screen, podium, pointer, microphone (both lapel and free-standing)
- Catering: Continental breakfast with beverage service (water, coffee/tea, juices) and afternoon snack with beverage services (water, coffee/tea, sodas)
- Other: Padfolios for workshop attendees

Registration

Registration for the workshop will be handled using AIAA's standard approach:

- The workshop registrations fees will be: $260 early/$360 onsite.

Envisioned Workshop Process for Analysis Teams (May, 2015)

- Perform analyses
- Submit results
- Prepare informal presentations for workshop
- SciTech 2016
  - AePW-2
    - Present results
    - Results comparisons
    - Discussion of results
    - Path forward
  - Panel discussion???
- Re-analyze
- Publish at special sessions of conferences (which conferences?)
- Publish combined journal articles

AePW-2 Agenda Thoughts

- Incorporate fresh perspectives in how we organize the workshop
- Following past workshops:
  - Introductory material
    - Welcome & overview
    - Experimental data set
    - Geometry & grid system overview
  - Participant presentations
  - Workshop data summary & discussion
  - Path forward, re-analysis discussions
- Propose a roundtable discussion (1 hour? 2 hours?) for the SciTech conference a few days after the workshop
  - Brief overview of the activity
  - Summary of the data comparisons
  - Panel containing willing and eager analysis team members

April Action Items

- ALL: Send email with proposed conferences for special sessions in 2016-2017
- ALL: Ponder workshop framework; email suggestions or broach them as discussion topics on the next telecon
- ALL attending AIAA Aviation Conference in June: Plan face-to-face meeting?
- JEN: Generate a fancy schedule of events

April telecon summary

- Held on April 2, 2015 11 a.m.
- Next telecon May 7, 11 a.m. East Coast time in U.S.
- Updated analysis parameters matrix; uploaded to website
- Experimental data was added to website
- List of analysis teams produced
- Discussion of workshop dates
- Experimental data reduction showing “divot” in the FRFs to likely be physical
- Pawel showed animation of flutter solution at Mach 0.74 using FUN3D

March telecon summary

- **Website address: http://nescacademy.nasa.gov/workshops/AePW2/public/**
- Held on March 12, rather than March 5 (with the usual March daylight savings time issues)
- Next telecon April 2, 11 a.m. East Coast time in U.S.
- SU-2 doesn't have existing FSI capability.(Melike and Dave Schuster to talk about this?)
- Block-structured grids from AePW-1 are available, generated by Thorsten Hansen at ANSYS. (Thorsten and Pawel will work together to make those available on the new website.)
- The molecular weight of R-134a isn't the same as a standard property table shows (102 g/mol). The value derived using the listed properties is more like 98 g/mol. This is due to the practical issue of gas purity that is achieved in the wind tunnel. The values on the table are from the test data, where the purity was likely 95%'ish. (Pawel will add a line for molecular weight to the analysis parameters table.)
- Add the following to the table of analyses:
  - ATA Engineering (Eric Blades will run LoPsiChem)
  - AFRL (Rick Graves will run FUN3D)
  - Milano Polytechnico (Sergio Ricci will run numerous codes)
- Please send comments regarding the distributed slides. In particular, are you okay with the abstract submittal form?
- With regard to submitting data to the workshop for comparison:
  - Can you provide results in matlab?
  - How do you feel about providing them in a data structure in matlab?
- Doublet lattice aeroelastic solution results:
  - Bimo and Jen will work to present the results to date at the next telecon
  - We will put the bulk data file, including the aero model and the flutter cards on the web site. This can serve as a basis for those who might want to use correction methods, etc.
- Temporal convergence results
  - Organizations may not have the resources to perform the temporal convergence study for all grids. It is suggested that this be done for a grid resolution where things look to be spatially converged. Experience at NASA has shown qualitatively different results for the unstructured coarse grid than those observed for the finer grid resolutions.
  - The flutter results at low Mach number (Mach 0.74) have shown great variation with regard to time step size. The predicted aeroelasticity stability of the system has been shown to be a function of the time step size and the subiteration convergence level.

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Experimental data analysis presented on April telecon:

Summary of AePW-2 Case 1 analysis

There is energy being transferred from 10 Hz to the superharmonics (20 and 30 Hz) for the sensors near the shock.

Currently, it appears to be physical, not mathematical (i.e. NOT a function of the Fourier analysis parameters chosen.)

The divot occurs for the sensor that is transferring the most energy to the other frequencies.

This appears to be a good case for NOT using Fourier analysis methods to analyze and compare the data.

Questions

- Is this a one-time event? i.e. is this an anomaly that we should ignore? i.e. Delete the data point from the FRF distribution?
- Does this occur at adjacent experimental points?

Point 863 is the AePW-2 Case 1 data point

Point	Mach	α, degs	Qbar, psf	Freq of oscillation, Hz	Amplitude of oscillation, degs	Run #
863	**0.7**	**3**	**170**	**10**	**1**	**15**
529	0.7	3	**100**	10	1	10
860	0.7	3	170	**5**	1	15
864	0.7	3	170	**15**	1	15
849	0.7	**1**	170	10	1	15
868	0.7	**5**	170	10	1	15

Summary of "adjacent" point analyses

- For cases at Mach 0.7, qbar 170 psf, aoa = 3 degs, the same "divot" behavior is observed
  - 10 Hz
  - 5 Hz
  - 15 Hz
- For the cases at identical Mach, qbar and forcing frequency (10 Hz), the other angles of attack show behavior that makes the baseline case's divot a logical point in a trend
  - $\alpha = 1°$
  - $\alpha = 5°$
  - $\alpha = 10°$
- For the qbar 100 psf case, there was no divot in the FRF magnitude
- Varying and/or optimizing the Fourier analysis parameters didn't make large qualitative changes to the FRFs.

Feb Telecon Notes

- Attendees list (to be added)
- Suggested adding to website:
  - Participating teams and matrix with contact information
  - Experimental data (Action item taken by Jen.)
- Request made that the frequency response function information be available in both rectangular form (Re and Im components) as well as in polar (Mag and phase) form. (Action item taken by Jen.)
- Experimental results for Case 1. In the FRF magnitude, there is a sawtooth near the leading edge. What is the source of that? Physical? Sensor issue? (Action item taken by Jen.)
- Grids: structured grids were generated by NASA in plot3D format using Pointwise. The gridding guidelines still include the RSW and HIRENASD from AePW-1. Need to revise them so that they are not confusing. Revisit them also with regard to the Reynolds number.
- Nonlinear effects and LCO:
  - Discussion regarding hysteresis and identification of the neutral stability point
  - Discussion about experimental data sets, including a DLR study on LCO where there were trends with Mach number
- Process:
  - Think about what questions we are trying to answer
  - How do we tell the organizing committee that we are participating by performing analyses? Is there a website sign up or abstract submittal form that we mail?
- Note: following the end of the telecon, as the webex window was closing… it was noted that there were some questions and/or comments on the webex communication window. Apologies for not noticing them. The window closed before we could stop it. We are not smart enough to figure out the now-erased questions. Can you ask them again?
- Next telecon March 5, 11 a.m.

Mini-abstract from AePW-1

MRL and USF Contribution to AePW - 1

N. N. Thusiast_
Multielement Research Lab, Mail Stop 000, Happy Forks, VA 00000 email: m.n.thusiast@mrl.gov, (777) 777-7777
Soar N. Air†
University of Southern Flight, Mail Code 98765, Lofty Heights, TX 00000 email: s.n.air@usf.edu, (888) 888-8888

We intend to participate in the AePW-1, to be held April 21-22 2012 in Honolulu, HI. We plan to perform the following sets of computations:

Configuration 1 – RSW , Steady Case, i. M=.825, α=2 deg
Code: RANS-CFD-3D
Grid: Str-OnetoOne-C-v1 (supplied by AePW-1 committee)
Turbulence model: Menter SST

Configuration 1 – RSW , Unsteady Case, i. M=.825, α=2 deg, 10 Hz Same as above

Configuration 2 – BSCW, Steady case, M=.85, α=5 deg, 10 Hz Same as above

Configuration 2 – BSCW, Unteady case, M=.85, α=5 deg, 20 Hz Same as above

Configuration 3 - HIRENASD Configuration, steady, M=.8, Re=7 million, α =1.5 deg
Code: RANS-CFD-3DAe
Grid: Str-OnetoOne-C-v1 (supplied by AePW-1 committee)
Turbulence model: S-A

We plan to submit our results electronically by the March 20, 2012 deadline to the AePW-1 committee. RANS-CFD-3DAe is a Reynolds-averaged Navier-Stokes code developed by Et et al.,[1] widely used at the Multielement Research Lab. It is specifically formulated to work on three-element wing configurations. It uses point-matched grids, and is an upwind finite-volume structured code.
LES-CFD-3D is a large-eddy simulation code developed at the University of Southern Flight.[2] It employs 6th order central differencing in space and 3rd order temporal differencing, along with 9th order explicit filtering.

References

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