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2nd Ice Prediction Workshop
Welcome and Introduction

Organizing Committee

Sponsored by the AIAA Atmospheric and Space Environments
Technical Committee (ASE TC)

AIAA IPW-2 · Vienna, Austria · 22-23 June 2023

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Outline

➢ Yesterday's session

➢ Participants and Codes

➢ Test Case Summary

➢ AIAA Aviation Forum 2024

➢ IPW Permanent Archive

➢ Workshop Guidelines & Housekeeping

➢ Workshop Agenda

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Thursday Afternoon Session

13:00	13:10		**Ice Prediction Workshop—Background and Motivation** *Andy Broeren - NASA Glenn, Éric Laurendeau – Polytechnique Montréal*
13:10	13:25		**Summary of IPW-1** *Éric Laurendeau – Polytechnique Montréal*
13:25	13:45		**IPW-2 Test Cases** *Isik Ozcer – ANSYS Canada*
13:45	14:10		**Code-to-code Comparisons – Case 1** *Maxime Blanchet – Polytechnique Montréal*
			Questions / Discussion (5 minutes)
14:10	14:35		**Code-to-code Comparisons – Case 2** *Maxime Blanchet – Polytechnique Montréal*
			Questions / Discussion (5 minutes)
14:35	15:00		**Code-to-code Comparisons – Case 3** *Maxime Blanchet – Polytechnique Montréal*
			Questions / Discussion (5 minutes)

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IPW-2 Participants and Codes

ID	Organization	Code
02	Politechnico Di Milano	PoliMIce
03	Seoul National University	ICEPAC, 2023
04	JAXA	FaSTAR/In-house code
05	Gulfstream	NASA USM3D/LEWICE3D
06	ANSYS Canada	FENSAP-ICE v23R2
08	NTNU	FENSAP-ICE v22R2
09	Kingston University London	FENSAP-ICE v22R1
10	Polytechnique Montréal	CHAMPS-ICE
11	CIRA	SIMBA
12	TUBS	DICEPS 2D V3/FLUENT
13	ONERA	IGLOO3D v1.3.0.0
14	Bombardier	Dragon Ice Suite Version 1.2
15	Boeing	CFD++ Version 17.1/LEWICE3D
16	NRC	FLUENT / NRC morphogenetic model
17	NASA Glenn	GlennICE v3.1.0

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IPW-2 Test Case Summary

Case 1: CRM65 Midspan Hybrid (3D)

Case 2: CRM65 Inboard Hybrid (3D)

Case 3: RG-15 Low Speed Icing

IPW-2 Test Case Summary

IPW-2 Case no.	Configuration	AoA	Speed	T_{static} (°C)	T_{total} (°C)	LWC (g/m³)	MVD (µm)	Icing Time (minutes)
1.1	CRM65 Mid-span	3.7	130 kts	-3.6	-1.4	1.0	25	29
1.2	CRM65 Mid-span	3.7	130 kts	-8.5	-6.3	1.0	25	29
1.3	CRM65 Mid-span	3.7	130 kts	-26.0	-23.8	1.0	25	29
2.1	CRM65 Inboard	3.7	130 kts	-3.6	-1.4	1.0	25	29
2.2	CRM65 Inboard	3.7	130 kts	-8.5	-6.3	1.0	25	29
2.3	CRM65 Inboard	3.7	130 kts	-26.0	-23.8	1.0	25	29
3.1	RG-15 Small wing	4	25 m/s	-2.0	-1.7	0.44	24	20
3.2	RG-15 Small wing	4	25 m/s	-4.0	-3.7	0.44	24	20
3.3	RG-15 Small wing	4	25 m/s	-10.0	-9.7	0.44	24	20

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AIAA Aviation Forum 2024

➢ The AIAA Atmospheric and Space Environments Technical Committee will sponsor special sessions at Aviation 2024 dedicated to IPW-2 results.

➢ Please consider submitting an abstract for this conference.

➢ Abstract Deadline: early November 2023.

➢ Dates: 24-28 June 2024

➢ Location: Reno, Nevada.

➢ URL: https://www.aiaa.org/aviation/utility/about/future-aviation-dates

IPW Permanent Archive

➤ The IPW organizing committee is seeking to create a permanent archive for IPW-1 and IPW-2:
  – Test case data (CAD, grids, experimental results)
  – Participant results (such as final ice shapes)
  – Participant presentations (PDF)
➤ The current website location is hosted by NTNU and is not a permanent solution.
➤ Consent from each presenter/organization is required to submit data/presentations to a permanent repository.
➤ NASA is looking at a long-term repository for date generated by all AIAA workshops.

Workshop Guidelines/Housekeeping

➢ Everyone please sign attendance sheet.

➢ Please hold questions until the end of each presentation.

➢ Presenters should allow 3 to 5 minutes for questions.

➢ If presentations finish before allotted time, we will continue and use additional time for more Q&A, lunch or breaks.

➢ We will collect all final presentations and post to IPW website (www.icepredictionworkshop.com).

➢ Please do not take pictures or record video/audio.

➢ Lunch is provided by SAE in hotel restaurant.

Workshop Agenda

08:00	08:30	**Welcome and Introduction**		
		Andy Broeren - NASA Glenn, Éric Laurendeau – Polytechnique Montréal		
08:30	08:40	**Public Database Development Opportunity**		
		Richard Moser – AeroTex		

Break

08:50	09:10	Politechnico Di Milano	SU2 7.5.1	
		Alessandro Donizetti		
09:10	09:30	Seoul National University	ICEPAC, 2023	
		Soonho Shon		
09:30	09:50	JAXA	FaSTAR/In-house code	
		Kei Shimura & Yuki Ide		
09:50	10:10	ANSYS Canada	FENSAP-ICE v23R2	
		Isik Ozcer		

Break

10:30	10:50	Gulfstream	NASA USM3D/LEWICE3D	
		Gregory Gathy		
10:50	11:10	Polytechnique Montréal	CHAMPS-ICE	
		Maxime Blanchet		
11:10	11:30	CIRA	SIMBA	
		Francesco Capizzano		
11:30	11:50	ONERA	IGLOO3D v1.3.0.0	
		Adèle Veilleux		

Lunch

12:50	13:10	Bombardier	Dragon Ice Suite Version 1.2	
		Guy Fortin		
13:10	13:30	Boeing	CFD++ Version 17.1/LEWICE3D	
		Adam Malone		
13:30	13:50	NRC	FLUENT / NRC morphogenetic model	
		Pete Forsyth		

Break

14:10	14:25	NTNU	FENSAP-ICE v22R2	
		Richard Hann		
14:25	14:40	Kingston University London	FENSAP-ICE v22R1	
		Ifrah Mussa		
14:40	14:55	TUBS	DICEPS 2D V3/FLUENT	
		Denis Sotomayor-Zakharov		
14:55	15:10	NASA Glenn	GlennICE v3.1.0	
		Thomas A. Ozoroski		

Break

15:30	16:00	**Summary and Wrap-up**	
		Andy Broeren - NASA Glenn, Éric Laurendeau – Polytechnique Montréal	

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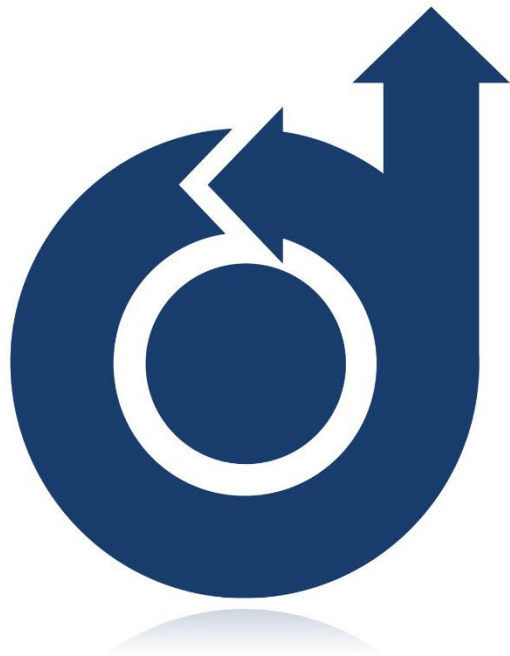
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Motivation and Background

Motivation

- Assess the current capabilities of 3D icing simulation tools.
- Bring together code developers and user communities.
- Identify areas that need additional research and development.

Background

- SAE AC-9C Meeting, Reno, October 16, 2018
    - Pitched the idea of an Ice Prediction Workshop
    - Reviewed NATO RTO Comparison Workshop conducted in 2000.
- SAE AC-9C Meeting, Minneapolis, June 17, 2019
    - Decided to go forward and began assembling a committee of volunteers.
    - Kick-off meeting held on November 20, 2019 with goal of 1st IPW in June of 2021 in conjunction with the AIAA Aviation Forum.

IPW-1 Summary

➢ Conducted virtually 26-29 July 2021prior to AIAA Aviation Forum.

➢ Featured 8 baseline test cases and 8 optional cases
  • Included: 2D geometry, multi-element airfoil, axisymmetric inlet, swept wing and large drop cases.

➢ Main objective was to baseline tool capability for a range of icing problems.

➢ Outstanding participation
  • 79 registered attendees (11 countries, 4 continents)
  • 21 presentations
  • 19 participants submitted data for comparison

➢ More details in presentation to follow

Workshop Principles

➤ This is a community effort to share knowledge, information, and head towards a common understanding of best practices for icing modeling and simulation. It should not be perceived as a competition of codes and groups.

➤ The goal is to focus on 3D icing simulation tools. This is not to diminish the importance, value and need for 2D tools. Past work on 2D tools and have provided the necessary groundwork for current 3D tools.

➤ Icing simulation tools have many common components such as airflow, particle trajectories (collection efficiency), mass and energy balances (surface water, heat transfer) and ice growth. The workshop is structured to evaluate compare the results of such components.

➤ We envision a series of workshops to address the wide-ranging problems in icing simulation.

Workshop Objectives (IPW-2)

➢ Focus on assessment of current 3D icing simulation capability for ice shapes on large swept wings and low-speed straight wing.
  - Define test cases and geometries based upon existing, known and publicly available geometries and data.

➢ Compare results for airflow (surface pressure distribution), collection efficiency, freezing fraction, surface temperature, heat transfer coefficient ice shape cross section, etc.

➢ Use the results of this workshop to identify cases for future workshops including how to gather experimental data from different facilities, "blind" comparisons and expansion into other problems such as engine icing, rotorcraft, ice protection systems, probes, iced aerodynamics, etc.

Organizing Committee*

Adam Malone	Boeing		Eric Laurendeau Maxime Blanchet	Ecole Polytechnique, Montreal
Alberto Pueyo	Bombardier		Eric Stewart	NAVAIR
Alessandro Donizetti Tommaso Bellosta	Politecnico di Milano		Ezgi Oztekin	FAA
Andy Broeren	NASA		Guilherme A. Lima da Silva	Aerothermal Solutions
Bryan Hinson	Textron Aviation		Ifrah Mussa	Kingston Univ. London
Chris Nelson	Siemens		Isik Ozcer	Ansys
Don Cook	Independent		Karthik Narayanasamy	Honeywell
Guy Fortin	Bombardier		Peter Forsyth	National Research Council
Richard Hann Markus Linder	Norwegian Univ. of Science and Technology		Richard Moser	AeroTex
			William Wright	HX5, LLC
Emmanuel Radenac	ONERA		Xin Yang	University of Oxford

*Regular contributors

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Acknowledgements

➢ Many volunteers on the organizing committee dedicated countless hours to preparing the test cases, developing meshes, manipulating CAD geometry, collecting experimental data, post-processing data, comparison plots, website hosting, etc., etc.

➢ SAE International for including IPW-2 into conference program.

➢ Tecplot for providing access to software for post processing.

Supporting Information

➢ SAE AC-9C Aircraft Icing Technology Committee
  • AC-9C Information: https://standardsworks.sae.org/standards-committees/ac-9c-aircraft-icing-technology-committee

➢ AIAA Atmospheric and Space Environments Technical Committee
  • ASE TC Information: https://www.aiaa.org/get-involved/committees-groups/technical-committees

➢ Ice Prediction Workshop: www.icepredictionworkshop.com

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