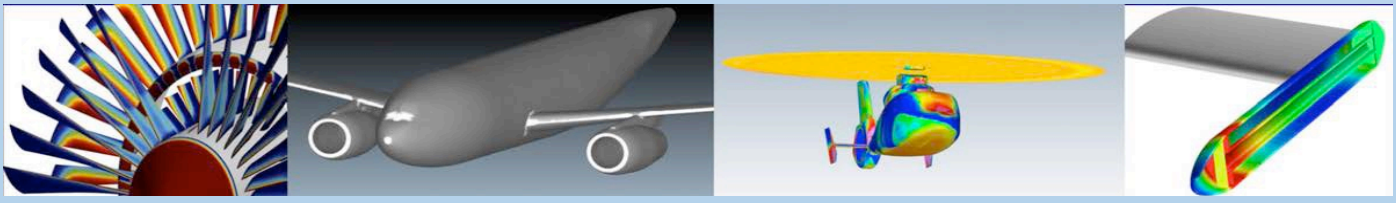
20th INTERNATIONAL ICING COURSE

CFD + EFD Simulation Methods for the
In-Flight Icing Certification of Aircraft, Rotorcraft and Jet Engines

a 5-day **online** course, Monday June 6 - Friday June 10, 2022

By instructors who have teamed up on engineering projects,
have certified aircraft and have published scientifically together!

Prof. Wagdi HABASHI, Director CFD Lab-McGill University and President CERTIF-ICE Inc.
Dr. Alberto PUEYO, Senior Engineering Specialist & Lead Icing Aero, Bombardier Aviation
with the participation of ANSYS-Canada



The 19th International Icing Course was held online in October 2021 and was a resounding success (see comments at end)
with 26 participants from 11 countries:
Canada, Brazil, USA, France, Poland, Switzerland, U.K., India, Singapore, South Korea and Turkey

The 20th International Icing Course will also be held online and is a timely opportunity to attend this unique course
with no absence from work, no visa requirements, and no travel expenses

Come and See the Best Simulation Tools for Certification

For an aircraft, rotorcraft or jet engine to obtain a type design certification, it must be demonstrated that it can sustain safe flight into known or inadvertent icing conditions. The icing certification process involves CFD (Computational Fluid Dynamics) analyses, wind and icing tunnel testing (EFD: Experimental Fluid Dynamics), all considered "simulation", and final demonstration of compliance through Flight Testing in Natural Icing (FFD: Flight Fluid Dynamics).

Modern 3D CFD-Icing methods such as FENSAP-ICE, working as a direct extension of CFD-Aero technologies, have become an indispensable, if not a primary tool, in the certification process. They are rapidly replacing 2D and 2.5D methods (**airfoils don't fly; aircraft do)**. They enable *analyzing the aircraft (fuselage, wing, engines, nacelles, cockpit windows, sensors, probes, etc.) as a system and not as an assemblage of isolated components*. The judicial integration of CFD-EFD simulation tools provides a cost-effective aid-to-design-and-to-certification, when made part of a well-structured compliance plan. CbA (Certification-by-Analysis) being a current "hot" subject; this course puts it into real practice, providing efficient tools and showing examples of capabilities and limitations.

The course will show how modern 3D icing codes are "predictive" as they are based on highly validated physical models (Scientific VVV lecture). Just as one example, critical ice shapes identification and corresponding aerodynamic penalties based on 2D airfoil calculations may be inaccurate if not altogether misleading as wings have breaks, sweep, twist, spanwise flows, propeller and engine effects, etc. that greatly affect/modify/delay stall and its propagation.

The course will also show how Reduced Order Models can make fully-3D calculations inexpensive (yielding **3D CFD with 10-20 million points + impingement + icing + performance in 1/100th of a second**, after the calculation of an appropriate number of "snapshots": this is even faster than 2D panel methods calibrated codes!) and enable rapid identification of aerodynamic and thermodynamic critical points in a structured way and not a heuristic one.

The inclusion of icing requirements at the aerodynamic design stage allows a more comprehensive exploration of the combined aerodynamics/icing envelopes, optimized IPS design, and focused/reduced wind tunnels, icing tunnels and flight tests. The end result is a faster design, faster testing, faster and more complete natural icing campaign, and a safer aircraft that is easier to certificate and that remains problem free during its lifecycle.

This course is structured to be of equal interest to aerodynamicists, icing, environmental systems and flight simulation engineers, regulators and Designated Engineering Representatives. *Detailed knowledge of CFD is not necessary*.

The lectures cover the major aspects of in-flight icing simulation, ice protection systems and handling quality issues. The instructors bring an amalgam of knowledge, as scientists who have developed codes in current use and engineers with certification experience combining CFD-EFD and FFD, along with cost-effective simulation methods widely used internationally for certification of aircraft for flight into known icing.

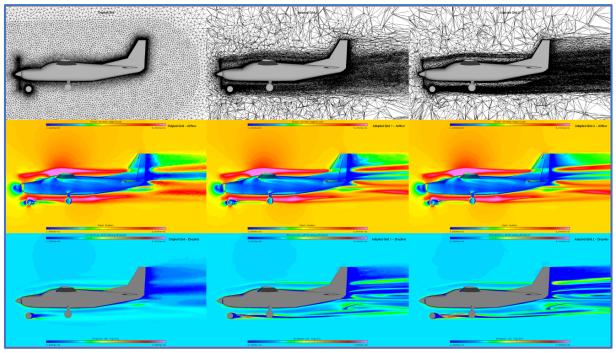
"Online" Course Details

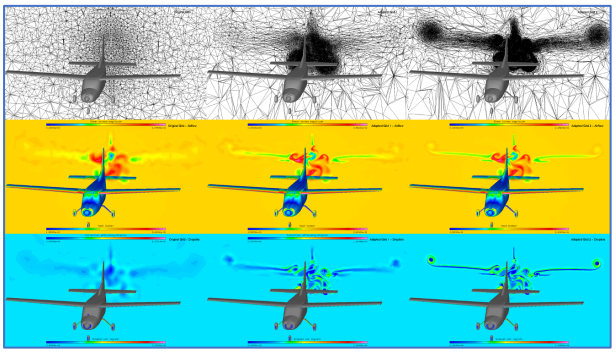
- The course will be given online, using ZOOM, from Monday June 6 to Friday June 10, 2022
- The course will *tentatively* * start at 9 am EDT and end at 1 pm EDT, followed by an optional interactive Q&A session
- * Lecture times might slightly change depending on the participants time zones
- All lectures are 75-minute long
- Course confirmation will start at 10 participants and registration will close at 30 participants
- The course reserves the right to accept or refuse participants
- To promote interaction and to prevent the proliferation of the course content:
    - Attendees will be requested to leave their video feed on
    - Videotaping will NOT be permitted, and
    - Course notes will be made available to attendees on a dedicated website, with no downloading

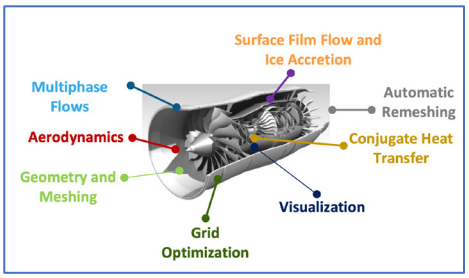
Make the move to modern

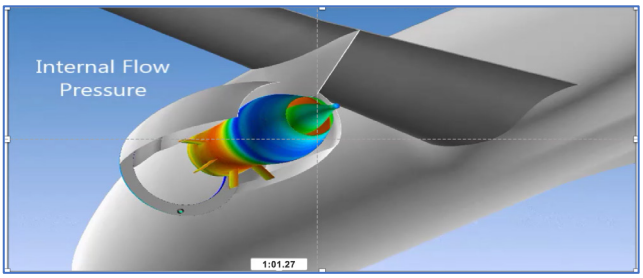
3D “Aircraft-Based” coupled CFD-(Aero + Icing) system analyses

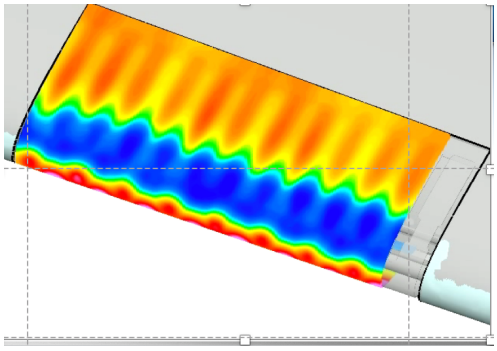
Airfoils don’t fly ; Only Aircraft do

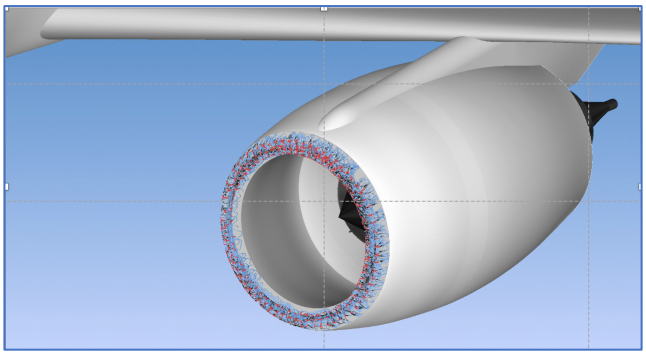


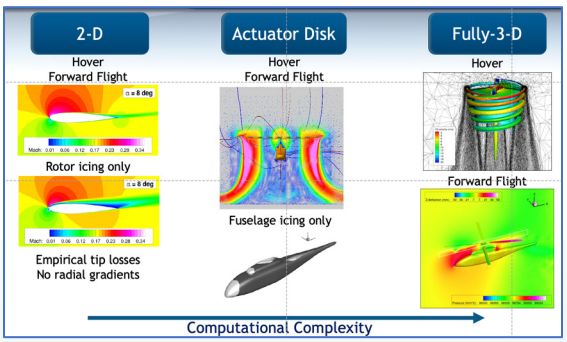


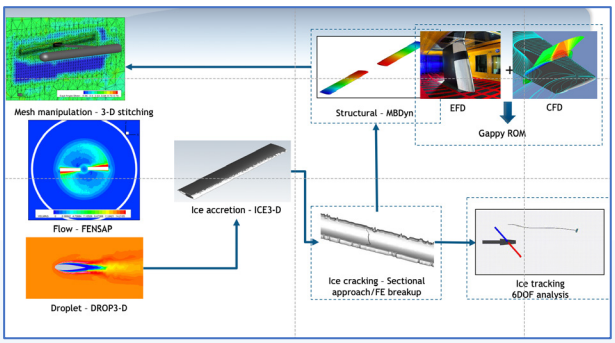












Join a Prestigious Community of Participants

Over 100 organizations from 22 countries

ADD (South Korea)
Agusta Westland (Italy)
ANSYS, Inc. (USA, Canada, Germany, Turkey)
Airbus (France, Germany, Spain, U.K.)
Aselsan (Turkey)
ATSi (Brazil)
Austrian Institute of Technology (Austria)
Aviadvigatel OJSC (Russia)
Aviation Partners (USA)
AVIC Commercial Engine Company (China)
Barcelona Supercomputing Center (Spain)
Battelle Memorial Institute (USA)
Bell (USA, Canada)
Beihang University (China)
Beijing Vision Strategy Technology (China)
Boeing (USA)
Bombardier Aerospace (Canada)
CAE Inc. (Canada)
Central Institute of Aviation Motors (Russia)
China Helicopter (China)
Collins Aerospace (India, Poland)
COMAC Flight Test Center (China)
Commercial Aircraft Company of China - COMAC (China)
Daher Socata (France)
Dassault Aviation (France)
DLR (Germany)
Dornier Seawings (Germany)
Dowty Propellers (U.K.)
DRD Technology (USA)
DSO (Singapore)
EADS (Germany)
École de technologie supérieure (Canada)
EDR & Medeso (Sweden)
EMBRAER (Brazil)
Eurocopter (France)
Evektor (Czech Republic)
First Aircraft Institute - AVIC (China)
General Atomics Aeronautical Systems (USA)
General Electric (USA)
Goodrich (USA)
Gyeongsang National University (South Korea)
Hamilton Sundstrand - UTC (USA)
Harbin Aircraft Industry Group - AVIC (China)
Honda Aircraft Engine R&D Center (Japan)
Hurel-Hispano (France)
Industria de Turbo Propulsores - ITP (Spain)
Ingeliance Technologies (France)
Instituto Nacional de Técnica Aeroespacial (Spain)
Korean Aerospace Industries (South Korea)
Korean Air (South Korea)
Liebherr (France)
Lockheed Martin Aerospace Corp. (USA)
Luleå University of Technology (Sweden)
McGill University (Canada)
Meteo France (France)
MHIRJ Aviation Group (Japan, Canada)
MTC (Egypt)
Ministry of Aviation U.K. (U.K., USA)
Nanjing U. of Aeronautics & Astronautics (China)
National University of Singapore (Singapore)
Northrop Grumman (USA)
ONERA (France)
Pall Aerospace (U.K.)
Pilatus (Switzerland)
Pratt & Whitney (Canada)
QinetiQ (U.K.)
Rolls-Royce (U.K.)
Russian Helicopters (Russia)
SAAB Aerosystems (Sweden)
Sabena Technics (France)
Shanghai Aircraft Design & Research Institute - SADRI (China)
Shenyang Aero Engine Research Institute (China)
SNECMA Moteurs (France)
SONACA (Belgium)
Swiss Federal Office of Civil Aviation (Switzerland)
Transitiels Technologies (France)
TUPOLEV (Russia)
Turkish Aerospace Industries (Turkey)
ULTRA Electronics (U.K.)
Università di Trento (Italy)
UTC Aerospace Systems (Poland, USA)
Vattenfall (Norway)
Vestas Tech R&D (Denmark)
Williams International (USA)

Attended by major airworthiness agencies and safety boards

Civil Aviation Administration of China - CAAC (China)
European Aerospace Safety Association - EASA (European Union)
Federal Aviation Administration - FAA (USA)
Interstate Aviation Committee - MAK (Russia)
Korea Certification Agency (South Korea)
National Transportation Safety Board - NTSB (USA)
Swiss Federal Office of Civil Aviation (Switzerland)
Transport Canada Civil Aviation - TCCA (Canada)

Course held for 20 years in 8 countries, over 3 continents

Internationally, online 2022
Internationally, online 2021
Battelle Memorial Institute, Ohio, USA, online, 2020
McGill University, Montreal, Canada, 2020 (canceled: pandemic)
McGill University, Montreal, Canada, 2016-2019
Barcelona Supercomputer Center, Barcelona, Spain, 2014
Fort Worth, Texas, USA, 2013
École Centrale de Lyon, Lyon, France, 2012
COMAC-SADRI-CAAC, Shanghai, China, 2011
Gyeongsang National University, Jinju, South Korea, 2010
University of Nevada Las Vegas, Las Vegas, USA, 2009
Universidad de Sevilla, Sevilla, Spain, 2007
Barcelona Supercomputer Center, Barcelona, Spain, 2006
European Aviation Safety Agency, Köln, Germany, 2005, 2015
McGill University, Montreal, Canada, 2004
The University of Cambridge, Cambridge, U.K., 2003
Florida International University, Miami, USA, 2002
Universitat Politècnica de Catalunya, Barcelona, Spain, 2002

Tentative Course Agenda

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Lecture 1 Fundamentals of In-flight Icing (Prof. Wagdi G. HABASHI)	*Lecture 4* Hybrid Simulation: CFD + EFD (Dr. Alberto PUEYO)	*Lecture 7* Operating in Known-icing: Aerodynamic Impact, 1 (Dr. Alberto PUEYO)	*Lecture 10* Simulation Methods Used in the Certifcation of Helicopters (Prof. Wagdi G. HABASHI)	*Lecture 13* An Introduction to Certification Rules (Dr. Alberto PUEYO)
Lecture 2 CFD for In-flight Icing (Prof. Wagdi G. HABASHI)	*Lecture 5* CFD for Anti-icing & De-icing (Mr. Cristhian ALIAGA)	*Lecture 8* Operating in Known-icing: Aerodynamic Impact, 2 (Dr. Alberto PUEYO)	*Lecture 11* Simulation Methods Used in the Certification of Aircraft, 1 (Dr. Alberto PUEYO)	*Lecture 14* Version Control, Verification, Validation (Prof. Wagdi G. HABASHI)
Lecture 3 Ice Protection Systems (Dr. Alberto PUEYO)	*Lecture 6* CFD for SLD and Ice Crystals (Mr. Cristhian ALIAGA)	*Lecture 9* Simulation Methods Used in the Certifcation of Jet Engines (Dr. Isik OZCER)	*Lecture 12* Simulation Methods Used in the Certification of Aircraft, 2 (Dr. Alberto PUEYO)	*Lecture 15* Reduced Order Modelling: The Road to CbA (Prof. Wagdi G. HABASHI)
Interactive Q&A Period	Interactive Q&A Period	Interactive Q&A Period	Interactive Q&A Period	Wrap-Up Q&A Period CERTIFICATES

Comments from Participants:

".....Presentations are excellent!"

".....Thank you for a great course!"

".....Excellent speakers!"

".....The speakers were knowledgeable."

".....Material is clear and comprehensive."

".....Amazing to see the validated 3D certification tools, when some people are still using 2D."

".....Cost reasonable with respect to other courses."

".....Response regarding registration and logistics was prompt!"

".....I found it extremely useful and thought provoking."

".....The 3D CFD tools will be of great value to inform our supplemental certification activities."

".....I only wish I could have done your course sooner!"

".....The course fully met my expectations and provided the information that I needed."

".....Many thanks for your delivery of an excellent course, presented by (obviously) very talented and very interested presenters!! I found the 5 days enthralling and incredibly interesting and I thank you all for a wonderful insight into the world of ice and ice issues on aircraft."

".....I found it extremely enlightening, and the delivery was excellent. I am so glad I was able to attend this course online."

"......I wish to thank you for the awesome course."

"......The whole experience and the excellent delivery by all your experts, has been extremely enlightening."

"......I just wanted to congratulate you and the instructors for these great lectures on icing: the variety of topics presented by all these knowledgeable and passionate instructors was impressive, especially for the limited time they had, Bravo!"

"Electronically Fillable" Registration Form

20th International Icing Online Course, June 6-10, 2022

Title: ○ Prof. ○ Dr. ○ Mr. ○ Mrs. Date: _____

First Name:_____Family Name: _____

Organization / Company: _____

Division / Dept: _____

Mailing Address: _____

_____

City: _____ZIP / Postal Code:_____

State / Province: _____Country: _____

Phone: _____

E-mail: _____

Signature: _____

Registration Fee:

◉	1 person	$1700 USD
○	2 persons from the same organization	$1500 USD each
○	3+ persons from the same organization	$1300 USD each
○	Airworthiness authorities personnel, DERs	$850 USD each
○	Students	$600 USD each

Payment: ***By credit card****, https://20th-international-icing-course.eventbrite.ca*

Payment: ***By bank transfer***, National Bank of Canada, 500, Place D'Armes, Montreal, QC Canada H2Y 2W3
Swift Number: BNDCCAMMINT - Account: 0006-14601-00804-65

Payment: ***By USD check****, mail to:* CERTIF-ICE, 2385 Lakeshore Drive, Dorval, QC, Canada H9S 2G7

For registration, please mail this form to: Jenny@certifice.com

Please note that completing the registration form is only a placeholder: registration is complete only when full payment is received at the latest 3 weeks before course starts.
The course reserves its rights for admission.
Cancellations are at a 5% service fee, up to 3 weeks before the course date. No cancellations accepted after that date. For any additional information, please contact Jenny@certifice.com