Institute for Aerospace Research: annual report 1990-1991

National Research Council of Canada. Institute for Aerospace Research

National Research Council Canada
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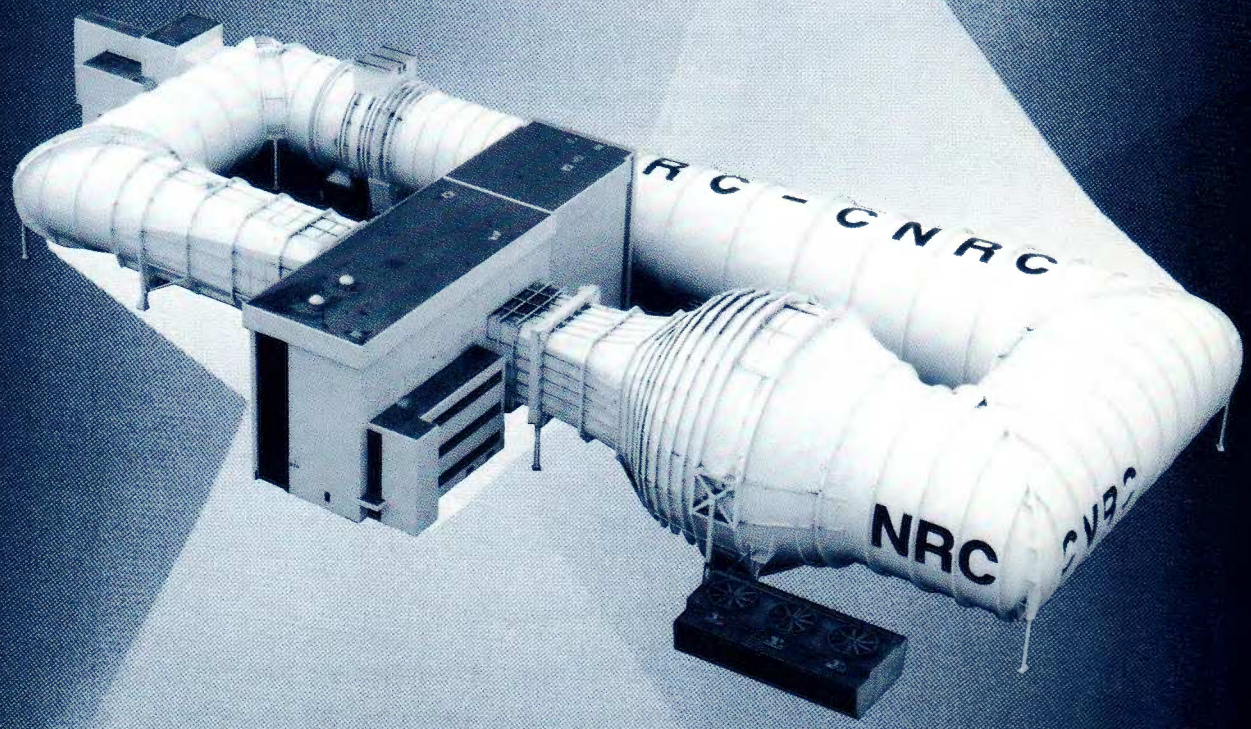
NRC·CNRC

Institute for Aerospace Research

Annual Report

1990 → 1991



Canada

IAR

THE NATIONAL RESEARCH COUNCIL

The National Research Council of Canada (NRC) is the premier science and engineering organization of the Government of Canada. In 1990-91, it had an annual budget of roughly 400 million dollars and more than 3,000 employees working in research institutes and a variety of programs and facilities across the country. NRC accounts for about 10% of federal expenditures on science and technology, and provides technical advice and assistance to more than 500,000 Canadians annually.

NRC serves the needs of Canadians by helping to maintain and enhance the prosperity and competitiveness of the country through:

- the support of national science and engineering activities;
- the performance of research and development;
- the stimulation of investment in research and development; and
- the development and provision of vital expertise and knowledge.

To this end, NRC is both responsive and flexible, achieving its goals in partnership with others, including industry, universities and governments.

Several fundamental corporate values sustain NRC and the activities it carries out and supports:

- NRC is committed to excellence and will maintain the highest possible standards in its work;
- NRC values its employees and has an historical dedication to staff excellence. It has one of the most highly qualified and experienced work forces in Canada;
- NRC values innovation and strongly supports the pursuit of new developments that can improve Canada's social and economic well-being and competitiveness;
- NRC values its partners and clients and knows that Canadians expect it to provide solutions to problems that have not been solved elsewhere;
- NRC is committed to service to the public;
- NRC supports accountability and performs its responsibilities in a manner which constantly ensures that Canada's investments in science and technology are yielding the highest national benefits.

NRC's INSTITUTE FOR AEROSPACE RESEARCH

"The Mission of the IAR is to undertake, assist and/or promote research and development in support of the Canadian aerospace community in matters affecting the design, manufacture, performance, use and safety of aerospace vehicles."

The objectives of the Institute are:

In collaboration with industries, universities and government agencies:

- To undertake and promote research and development of strategic significance in support of the Canadian aerospace community in matters affecting the design, manufacture, performance, use and safety of aircraft and space vehicles;
- To support the Canadian aerospace community through the provision of expertise and the development, provision and application of unique national research facilities;
- To promote and apply these facilities and associated expertise in the solution of problems of economic and social concern.

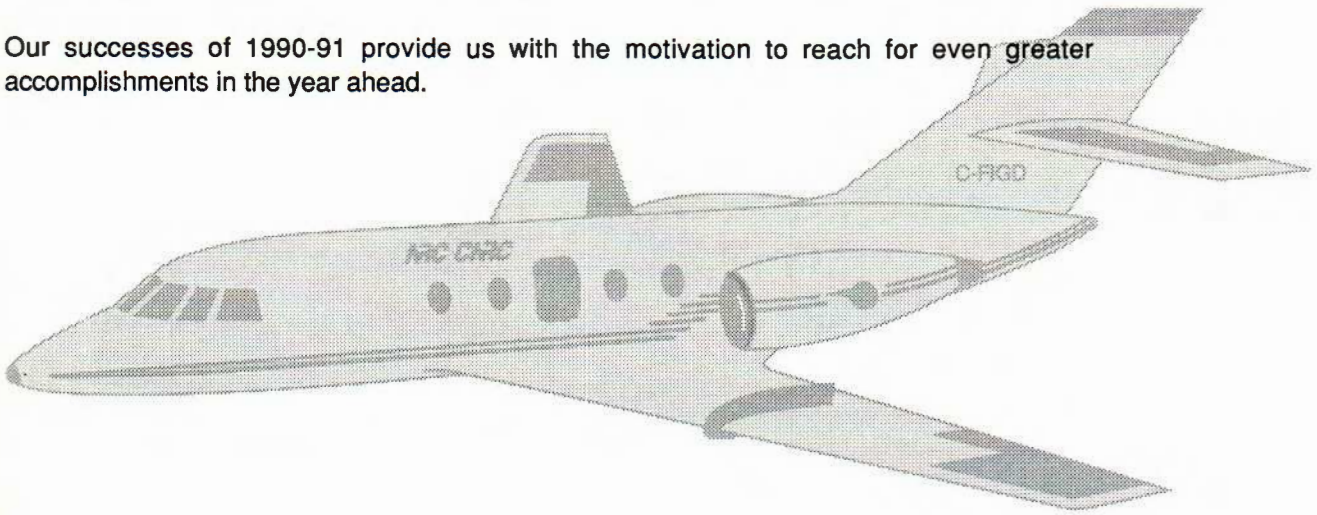
DIRECTOR GENERAL'S MESSAGE

The year 1990-91 has been an especially busy and productive year for the Institute for Aerospace Research. As indicated in the previous Annual Report, the Institute changed its name during the summer of 1990, and some organizational changes were effected as well, as we regrouped our resources following an intensive down-sizing.

The level of interactions with clients and collaborators has increased steadily. Revenue generation reached the highest level ever achieved, at somewhat over $3 million for the fiscal year. Our wind tunnels, in particular, were kept very busy, with a substantial level of international business. At the same time, the various Laboratories expanded their collaborative work with the Canadian aerospace industry.

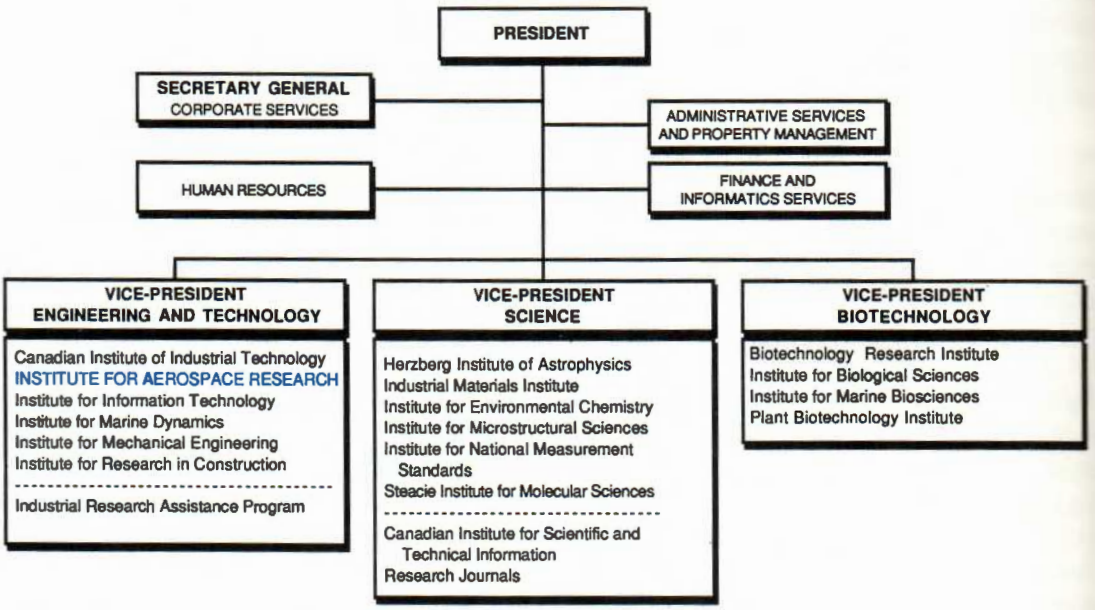
Of particular significance are our continued heavy involvement in the DND International Follow-On Structural Test Program (IFOSTP) for the CF-18; a major collaborative undertaking with CAE Electronics Ltd supporting their development of a Dash 8 flight simulator; new and expanded collaborations with Boeing Canada, deHavilland Division; the acquisition of a Falcon 20 aircraft to be used for a range of collaborative projects with other Government Departments; successful negotiation of a follow-on phase of aircraft aerodynamics research related to high manoeuvrability, with DND and the US Air Force; and occupancy of additional space to enable expanded work in aircraft structures research.

Our successes of 1990-91 provide us with the motivation to reach for even greater accomplishments in the year ahead.

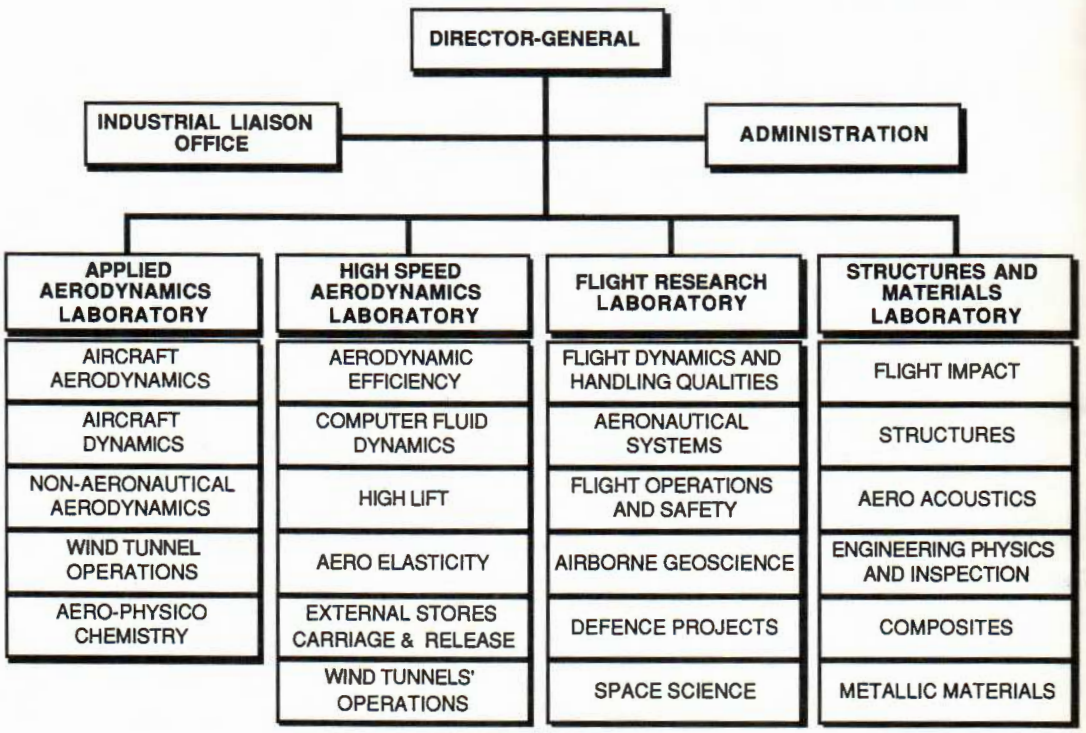


Gerry F. Marsters

NRC ORGANIZATION



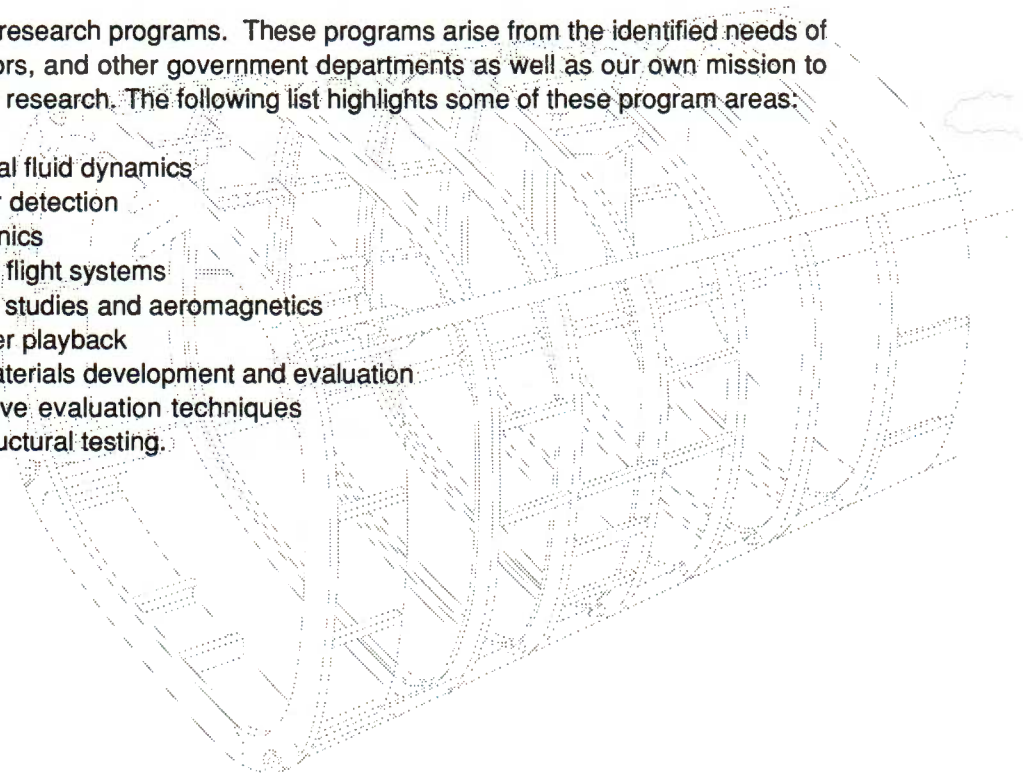
INSTITUTE FOR AEROSPACE RESEARCH



RESEARCH PROGRAMS

IAR undertakes many research programs. These programs arise from the identified needs of our clients, collaborators, and other government departments as well as our own mission to carry out leading-edge research. The following list highlights some of these program areas:

- computational fluid dynamics
- trace vapour detection
- flight mechanics
- avionics and flight systems
- atmospheric studies and aeromagnetics
- flight recorder playback
- structural materials development and evaluation
- nondestructive evaluation techniques
- full-scale structural testing.



OPERATIONAL PLAN HIGHLIGHTS

March 31, 1991 marked the end of the first year in IAR's current five year (1990-91) Business Plan.

In the first year of the Plan the IAR expected "to make adjustments to its projects to meet resource targets, rather than to make wholesale changes". However, two downsizing exercises and the departure of several staff members provided an opportunity to make significant organizational changes within the Institute. Five laboratories became four as the responsibilities for various sections and facilities were shifted.

IAR continued to undertake strategic R&D, to support Canadian industry and other government departments (OGD's), and to promote its people and facilities. Revenue through fee-for-service and collaborative projects increased significantly to over $3.2 million and expenditures on behalf of OGD's exceeded $4.8 million.

IAR expects to continue to see such high levels of external support throughout the coming year.

APPLIED AERODYNAMICS

Canadair CL-601RJ in ground effect

Experimental Facilities

The Applied Aerodynamics Laboratory (AAL) operates three low-speed continuous, closed-loop wind tunnels, a 2 m x 3 m, a 1 m x 1 m, and a 5 m diameter vertical tunnel, in addition to a small water tunnel and a 0.4 m x 0.9 m trisonic, intermittent suction tunnel. This year the facilities were used in 13 different experimental studies for industry, government, and university clients, as well as for in-house projects. Work for industrial clients included advanced propulsion testing with Boeing (deHavilland) and Pratt & Whitney Canada, ground proximity aerodynamics investigations on the Canadair CL-601RJ and testing of an aircraft ski installation for Field Aviation. An acoustic liner was designed, tested, commissioned and used for aircraft propulsion/noise studies with Boeing (deHavilland). The aerodynamic behaviour of a new ILS ground antenna design was determined during a test conducted for Transport Canada. Internal research activities included an investigation into the effects of ice contamination on the aerodynamic characteristics of wings, and an investigation into the sources of wind tunnel noise.

Standard Dynamics Model

Aerodynamics of Manoeuvring Aircraft

To gain insight into the complex unsteady flow phenomena associated with aircraft manoeuvring at high angles of attack, investigations were undertaken to measure the pitch and yaw stability derivatives of an aircraft model, and of the buffet forces acting on its lift and control surfaces. At the same time, the vortical flow field around the model was studied using a laser light-sheet flow visualization technique. Buffet, flow visualization, and dynamic stability tests were performed on the Standard Dynamics Model, a generic fighter aircraft configuration, which was sting-mounted in the Laboratory's 2 m x 3 m low-speed wind tunnel.

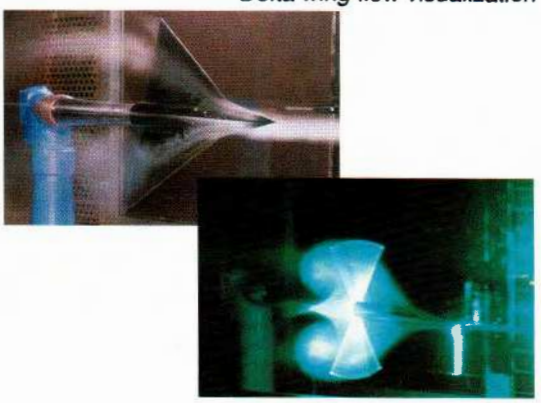
Unsteady aerodynamic excitation associated with buffet arises from both separated and impacting vortical flows. A primary goal of this investigation is to compare the excitation for wing symmetric and anti-symmetric bending in the presence of sideslip. Another goal is to determine whether a common limit exists at high incidence for excitation resulting from impacting vortical flows.

Non-Linear Aerodynamics

A unique large-amplitude, high-rate dynamic wind-tunnel apparatus has been developed under a joint research program with DND and USAF. Experiments conducted on a delta wing at high angles of attack yielded data that contributes to elucidation of the complex unsteady vortical flow phenomena associated with large amplitude rolling motions such as encountered in wing rock.

The work has led to the development of a new representation of non-linear loads that provides significantly improved flight mechanics predictions in the non-linear unsteady flow regime. A recently commenced second phase of the joint program is intended to develop the capability to conduct dynamic tests involving very large amplitude and high-rate pitching motions to investigate dynamic lift in three-dimensional configurations.

Delta wing flow visualization

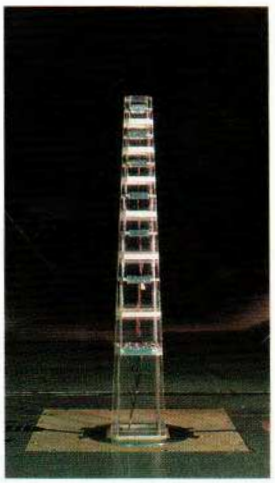


Non-Aeronautical Aerodynamics

The laboratory's expertise in aerodynamics and wind tunnel techniques is frequently sought by industrial and OGD clients for diverse non-aerospace applications, including wind loads on ground-based structures and the aerodynamic behaviour of surface vehicles.

In the tall building study, the wind loads on a 1:200-scale aeroelastic model of a 500 meter high building were measured in the 9 m x 9 m tunnel for the Fujita Corporation, in cooperation with the University of Ottawa. The model was dynamically scaled to simulate the deflection of the building under windy conditions. It was fabricated at the AAL and mounted on a turntable in the tunnel floor in a gusty wind simulation produced by the AAL-developed turbulence spires. In another major project, the aerodynamic stability of a full-scale model of a 5 meter tall ROTHR antenna was determined when covered with snow or ice, for the Raytheon Company.

Measurements of the mean aerodynamic forces on a range of full-sized passenger cars were made in the 9 m x 9 m tunnel for the Ford Motor Mfg. Ltd. to establish aerodynamic effects on fuel consumption and on cross-wind handling. In another study for the Ty-Crop Corporation, the water tunnel was used to investigate possible aerodynamic effects on stone throwing by an ore-hauling truck in summer and to study the snow cloud generated by it in winter.



Tall Building model

Aerial Spray Drift Studies

Off-target windborne droplet drift which inevitably occurs in aerial spray operations is a longstanding problem in forestry aviation. The Laboratory assists provincial and federal regulatory, health and environmental agencies and industrial partners in determination of the appropriate meteorological conditions and aircraft parameters which will allow adequate protection of the target species while minimizing the ecological impact. Controlled field experiments were carried out under the aegis of the Spray Efficacy Research Group (SERG) to measure the drift cloud from aerial releases in northern Ontario and New Brunswick forests. Lightweight chemical samplers, developed for suspension from tethered blimps, and an array of vector vanes, temperature probes and humidity sensors allowed quantification of the cloud mass as a function of atmospheric stability. A major finding of these studies has revised conventional wisdom, in that aerial spraying performed under turbulent atmospheric conditions was often found to result in significantly less off-target drift than that conducted under calm conditions.

Blimp for spray sampling

HIGH SPEED AERODYNAMICS

The High Speed Aerodynamics Laboratory (HSAL) is staffed by 52 scientific, technical and support personnel and is responsible for conducting aerodynamic research and administering two major wind tunnels.

Research Activities

During the year, research in experimental aerodynamics and in Computational Fluid Dynamics (CFD) was pursued along several avenues.

a) Experimental Aerodynamics

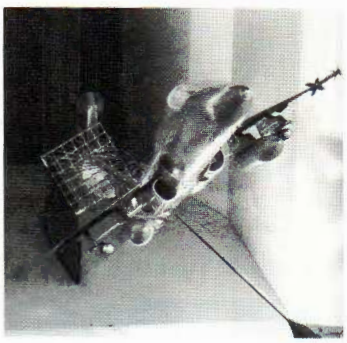
High angle-of-attack aerodynamics and buffeting flows

Aerodynamic and buffet characteristics of combat aircraft at high angle-of-attack are the subject of a continuing experimental program in the IAR 1.5 m x 1.5 m trisonic blowdown wind tunnel. Measurements are made in the transonic test-section with a 6% scale CF-18 model instrumented for steady and unsteady pressure measurement on the forebody, LEX, and a vertical fin. The fin response is measured by means of accelerometers and strain gauges. The flowfield in the vicinity of the vertical fins is studied through use of a 49-tube dynamic pressure probe. Loads data for the analysis of structural integrity of the vertical fin have been made in correlating unsteady pressure fluctuations on the vertical fin with the external pressure field as a means of understanding the development of buffeting flows.

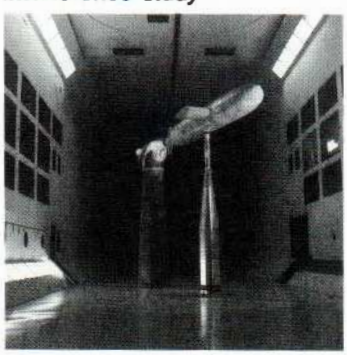
An extreme value statistics method has been developed to estimate peak buffet loads, using short duration experimental records.

The absolute value of the peak normal force coefficient acting on the vertical fin of the CF-18 has been determined for several angles-of-attack and Reynolds numbers. One and one-half seconds of data were found to be sufficient to give a good estimate of the asymptotic peak loads.

CF-18 model mounted in 1.5 m wind tunnel at high angle-of-attack.
Note: 49 tube dynamic pressure probe behind fin.



Submarine model for support interference study



Model support interference

Some investigation of support interference on bodies of revolution in low speed flow has been made in the 9 m x 9 m low speed wind tunnel. The application lies in measurements to study the aero/hydro mechanics of flow over the afterbody of a submarine model with rear mounted propellers, for which sting mounting is unsuitable.

b) Computational Fluid Dynamics

Wind tunnel sidewall boundary layer effects

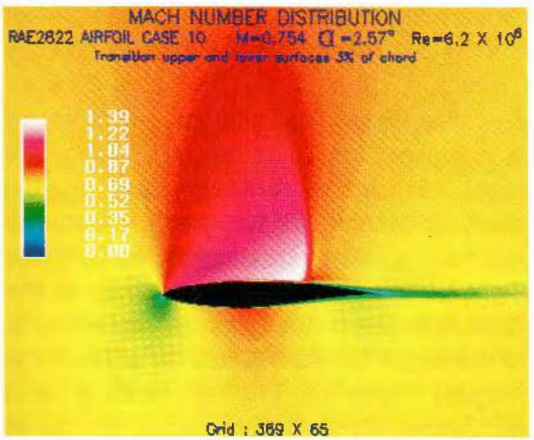
The effect of sidewall boundary layer growth in the 0.38 m x 1.5 m two-dimensional test-section of the blowdown wind tunnel is vital to proper interpretation of test data. The change in Mach number at the model over the measured freestream value can be significant in determining the pressure distribution of a supercritical aerofoil operating near its design point. To this end some analysis has been done by coupling an inviscid 3D wing code with a sidewall boundary layer growth code.

2D Euler code and boundary layer coupling

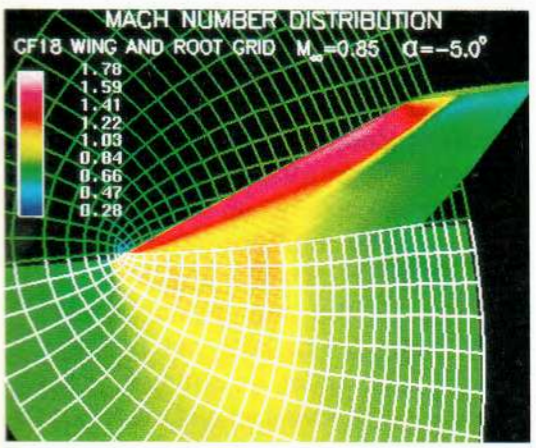
A mesh displacement procedure for coupling solutions to the inviscid Euler equations with a viscous boundary layer calculation for transonic flow about aerofoil sections has been implemented. Comparison of the numerical solution with experimental data obtained on a 12% thickness to chord ratio RAE2822 aerofoil has been made. Pressure distribution and the boundary layer parameters (shape factor, displacement thickness and fraction coefficients) are well predicted.

Navier-Stokes code application

A Navier-Stokes code, with thin layer approximation for run time economy, has been applied to aerofoil flow prediction. A pictorial representation of the Mach number distribution over the RAE2822 aerofoil is shown in the figure below. The extensive region of high speed flow on the upper surface terminating in a normal shock-wave is clearly shown as is the rapid growth of the upper surface boundary layer immediately behind the shock. The solution, obtained on the IBM RS/6000-320 workstation took 700 iterations – about one hour CPU time – while the time required on a CRAY2 super computer was six minutes.



3D wing flow calculation

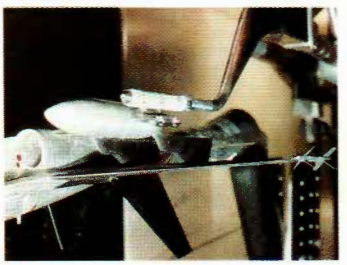


A multigrid Euler code, configured to compute steady transonic flow over isolated wings is being developed to provide load data for input to a flutter analysis program. Solutions to the wing pressure distribution for the CF-18 wing in the angle-of-attack range from -5 to +7 degrees and Mach numbers up to 0.95 have been obtained. The preceding figure illustrates the variation of Mach number on the underside of the wing at 0.85 Mach number and -5 degrees angle-of-attack.

Wind Tunnel Evaluations

1. 1.5 m x 1.5 m Trisonic Blowdown Wind Tunnel

Fourteen fee-for-service projects were conducted on behalf of domestic and foreign clients in the aircraft industry and the Department of National Defence. Total occupancy amounted to 145 days. The testing mode was evenly split between two-dimensional aerofoil measurements and full configurations in the transonic test-section. There was no requirement for measurements at supersonic speeds.



The photograph shows the experimental arrangement for a program conducted on behalf of DND. The purpose was measurement of aerodynamic forces and moments on an external store at various positions under the CF-18 attack aircraft after jettison. The store was mounted on a special positioning sting while the aircraft model was sting-supported from the roof of the transonic test-section.

2. 9 m x 9 m Low Speed Wind Tunnel

Fee-for-service tests were carried out for several clients, viz. Bombardier Inc.; Ford Motor Co.; Ontario Hydro; and Defence Research Establishment Atlantic; for a total occupancy time of 105 days. This facility provides wind tunnel evaluation service for a wide range of subjects from aircraft to automobiles, to terrestrial structures to undersea vehicles.

Half-model of Challenger

FLIGHT RESEARCH

The Flight Research Laboratory (FRL), located at the Uplands Research Complex of NRC, has approximately 55 scientific and technical staff with special knowledge in the area of experimentation in flight. It conducts research projects in its main program areas of Flight Mechanics and Airborne Science.

Aircraft Facilities

Dash 8 Series 100 aircraft used for flight testing

The FRL develops, maintains and operates a small fleet of eight research aircraft. There have been several changes to the fleet this past year. The last of the FRL's Bell 47G helicopters was sold, as was a Beech 18 that had been at the Laboratory for over 30 years. A Falcon 20, recently acquired from DND, arrived in March 1991 and will be equipped, initially, for microgravity research and microwave landing system (MLS) studies.

Flight Mechanics

The FRL cooperates with partners in the Canadian aerospace industries in the design, development, testing and evaluation of advanced aeronautical systems. The Laboratory also carries out independent and collaborative research to establish design standards and operational limits for modern aircraft with advanced control and display systems. In the past year, progress has been made in all areas of this program, for example:

- two experiments were conducted in the international study of handling qualities requirements for advanced military helicopters;
- the second flight phase was completed in the collaborative work with Transport Canada on curved, segmented approaches using microwave landing system (MLS) guidance; and
- the International Test Pilot School purchased a short course from IAR involving instruction and demonstration flights in the IAR Airborne Simulator.

Details of these and other Flight Mechanics projects may be found in the FRL Annual Progress Report.

During this reporting period, particular emphasis was directed to the following major projects involving IAR and Canadian industry:

Advanced Flight Simulator Math Model Development

CAE Electronics Ltd. and IAR are cooperating in the development of mathematical flight models of the deHavilland Dash 8 series aircraft for use in modern flight simulators. The models meet the precise requirements for certification by Transport Canada and the U.S./FAA as so-called Phase III simulators. Flight testing is being performed at the IAR, using IAR flight test instrumentation and special analysis techniques for model parameter estimation. Work is complete on both the flight testing and modelling phases of the Dash 8 Series 100 aircraft and fight testing of the larger Series 300 aircraft will occur in August 1991. The know-how and technology for these processes are being transferred to CAE and deHavilland.

Advanced Systems Research Aircraft (ASRA)

Progress has been made toward the development of an industry-university-government consortium, led by IAR, which will develop and use a new variable stability research helicopter as an advanced aircraft systems research facility. The new ASRA will replace the current, aging IAR Airborne Simulator in the mid to late nineties. Consultations with potential partners in industry and other government departments are well advanced and the final step,

an information workshop with interested university research groups, is being planned for the fall of 1991.

Airborne Science

The FRL is a national resource and centre of expertise in airborne scientific instrumentation, real-time computation and research flight operations. Progress in specific areas of this Program is outlined below:

Canadian Atlantic Storms Program

Planning is currently underway for FRL's participation in the second Canadian Atlantic Storms Program (CASP II), a joint project with the Atmospheric Environment Service (AES) that will be staged out of St. John's, Nfld. during January to March of 1992, with the Convair 580 to be extensively instrumented for cloud physics, cloud chemistry and atmospheric dynamics measurements.

Twin Otter Biospheric Studies

The Twin Otter has been developed as a world-class facility for the airborne measurement of the vertical fluxes of gases such as carbon dioxide, methane, ozone and water vapour. In a research collaboration with Ag Can, AES and NASA during the summer of 1990, the Twin Otter was involved in the Northern Wetlands Study, based at Moosonee, Ontario, and performed airborne flux measurements in the Hudson Bay Lowlands region. The FRL is also planning for its participation in a special ozone flux study in the San Joaquin Valley in California in cooperation with AES and Ag Can.

Polar Margin Aeromagnetic Project (PMAP)

In collaboration with DND and Energy Mines and Resources, the FRL has been involved in PMAP – a series of high resolution aeromagnetic surveys conducted in the high Arctic using the Convair 580. PMAP identified five block areas for which inadequate aeromagnetic survey coverage existed, one of which has now been completely surveyed. Upon completion of PMAP, a total area of approximately 500,000 km^2 will have been surveyed with a line spacing of 4 km.

Spotlight SAR Project

The DND-funded Spotlight SAR Project was completed at the end of 1990, with this prototype radar system successfully demonstrating its real-time target imaging and identification capability onboard the Convair. Follow-on collaborative work with DND will concentrate on enhancements to the radar system and a study of its susceptibility to jamming signals.

Flight Recorder Playback Centre (FRPC)

With the assistance of DND and outside contractors, the FRPC is just completing two major in-house system development initiatives, ADAAPS and Micro FRPS, which are modern, user-friendly engineering tools for the analysis and presentation of aircraft flight data. Both systems are currently in use in the FRPC and opportunities for commercialization are being sought.

Speech Research Centre

The Speech Research Centre collaborates with the Neil Squire Foundation and the Canadian Marconi Company in ongoing research activities related to speech recognition. Recent work includes development of a fly-by-voice speech recognition system using a Marconi prototype speech recognizer and the IAR Airborne Simulator.

The IAR Twin Otter is used in biospheric studies to measure the vertical flux of trace gases

Colour image of total magnetic field enhanced by gradiometry data from PMAP

A graphics-based demonstration of the fly-by-voice technology being developed for the Airborne Simulator

STRUCTURES AND MATERIALS

The mandate of the Structures and Materials Laboratory (SML) is to perform research and development in support of the Canadian aerospace community in areas affecting the design, strength, durability and structural integrity of aircraft and space structures.

Diffracto Sight Application to Rapid Inspection of Aircraft Structures

Diffracto Sight or D Sight is a new surface inspection technique. It is a simple optical arrangement involving a source of light and a retro-reflective screen. The technique is used for visualizing surface distortions, depressions or protrusions and is adaptable to the detection of any phenomena leading to a change in surface topography greater than 10 micrometers. D Sight is a real-time technique with particular application for the rapid inspection of large surface areas. In its basic configuration, the technique could be used directly as an enhancement to visual inspection. It has the potential of being automated or semi-automated through the use of computer vision techniques. Diffracto Ltd. of Windsor Ontario holds several patents for D Sight and has previously received funds from NRCC/IRAP to develop this technology. Diffracto currently markets D Sight systems for automotive applications.

Ambient

D Sight

Dash 7 fuselage section in ambient light and D Sight views

In 1987 it was suggested by the Institute that D Sight could have a potential as an aircraft structure NDI (Non-Destructive Inspection) technique. D Sight was used to locate indentations associated with low energy impact damage and edge delaminations in graphite/epoxy composites. The technique was shown to be very effective in locating nonvisible impact damage, and limited inspections of composite fighter aircraft structures have been very encouraging.

In metallic aircraft structures, D Sight has been shown to be capable of detecting cold worked holes, corrosion, and fatigue cracks associated with high stress intensity factors. Inspections of a commuter aircraft and of an aging jet transport have demonstrated the potential of the technique. The technique could be adapted in the near term for the regular inspection of aircraft structures for loose fasteners, corrosion and cracking.

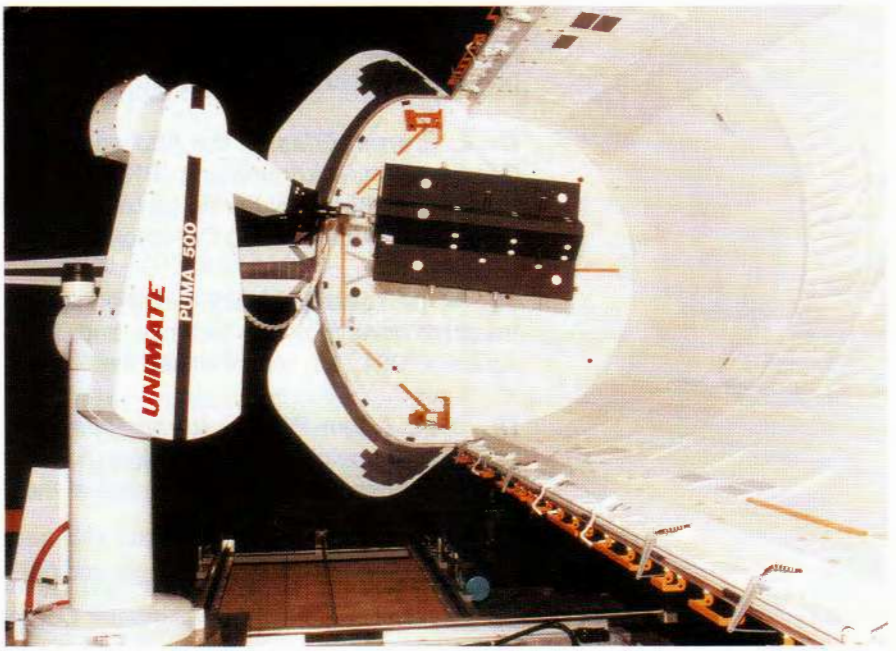
This work is being performed in collaboration with Diffracto Ltd. and has attracted interest from DND, Transport Canada, Boeing CAC, Douglas AC, USAF, and FAA among others.

Space Vision System

In collaboration with the Astronaut Program Office of the Canadian Space Agency, the Laboratory is preparing for the CANEX-2 Space Shuttle mission and flight tests of the Space Vision System (SVS). The SVS will be operated by Canadian Payload Specialist Steve MacLean on Shuttle Orbiter Flight STS-52 scheduled for launch in September 1992. Based on the principles of real-time video photogrammetry developed at IAR over the past several years, the SVS

processes imagery from video cameras in the shuttle cargo bay to determine the position and attitude of a targeted payload in real time. A variety of passive target arrays needed in the photogrammetric process are provided on the Canadian Target Assembly (CTA), a deployable Shuttle payload designed and constructed in the shops of the IAR Flight Research Laboratory.

The CTA will be grappled, berthed and manoeuvred through a series of trajectories using the Shuttle Remote Manipulator System (Canadarm) while SVS views of the CTA target arrays provide guidance information to the manipulator operator. Flight test data will be used to assess the effectiveness of machine vision sensors in on-orbit teleoperator tasks and highlight areas for further development. Preliminary work on an advanced version of the Space Vision System is underway and could lead to an improved sensor for servicing and assembly tasks performed by the Mobile Servicing System on the US/International Space Station.



SVS Vision System

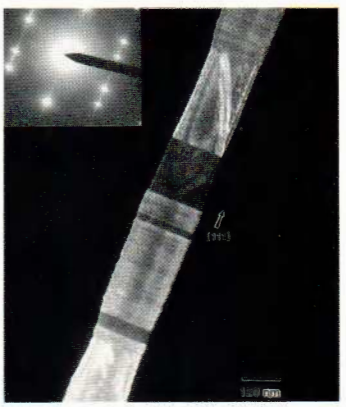
Ceramic Whiskers for Engine Components

To increase the temperature capability of gas turbine engines, most manufacturers are now experimenting with ceramic components. One of the ways to improve toughness in ceramics is to prepare composites using fibre or whisker reinforcement. A small Ontario company, Ceramics Kingston Céramiques Inc., is currently expanding its plant to produce whiskers which may be used as reinforcement in both ceramic and metal matrix composites. Silicon carbide whiskers produced by this company have been characterized in the Structures and Materials Laboratory. They have been found to be comparable to the best currently available (which are produced in Japan, are very expensive and of limited supply) in terms of average size (approximately 0.5 μm diameter, 25 μm long), size uniformity, defect structure, surface morphology, etc.

Two projects are underway in the laboratory to evaluate the properties of composites reinforced by SiC whiskers:

a) Ceramic matrix composites are being prepared by the hot isostatic pressing (HIPing) of silicon nitride powders, blended with sintering aids, and containing up to 25 volume % silicon carbide whiskers. The resulting material will be compared to commercially available HIPed monolithic silicon nitride (Norton NT-154); and

b) A new powder aluminum alloy (AA2080) from Alcoa is being blended with up to 30 volume % silicon carbide whiskers, HIPed and extruded. It is hoped that this material will have even better strength and stiffness than shown by the particulate composites for which this alloy was designed.



Dark field image of whisker showing twin orientation relationship along length of whisker

KUDOS

Ms. S. (Sylvie) Béland, of the Structures and Materials Laboratory, is the author of a book entitled "High Performance Thermoplastic Resins and Their Composites", which has been published by Noyes Publication, 1991, ISBN: 0-8155-1278-3.

Dr. L. (Lorne) Elias, of the Applied Aerodynamics Laboratory, was the invited guest of the German Bundeskriminalamt (BKA) at the International Symposium on Drug Detection at Wiesbaden Germany during December 11-12, 1990. Dr. Elias chaired the session on Trace Vapour Methods of Drug Detection.

Dr. M. (Miroslav) Mokry, of the High Speed Aerodynamics Laboratory, was granted a research award by the Science and Technology Agency of the Government of Japan in January 1991. Dr. Mokry visited the National Aerospace Laboratory in Chofu, Tokyo.

Dr. J.-P. (Jean-Pierre) Immarigeon, of the Structures and Materials Laboratory, was honoured by being named a Fellow of the American Society for Materials International (ASM). Dr. Immarigeon received his honour at the Annual Awards meeting held in Detroit in October 1990.

Mr. C.P. (Carl) Swail, of the Flight Research Laboratory, was presented with a service award from the Concurrent Computer Corporation Users Group. Mr. Swail received his award at the Interchange Conference banquet held in St. Louis on October 18, 1990.

ADVISORY BOARD

RECENT COLLABORATIVE PROJECTS

IAR undertakes collaborative projects where the partner's needs match those of the Institute. This "leveraging" of resources leads to larger, more comprehensive, and more efficient projects. Such collaborative efforts are even more important in these times of dwindling resources and fierce international competition.

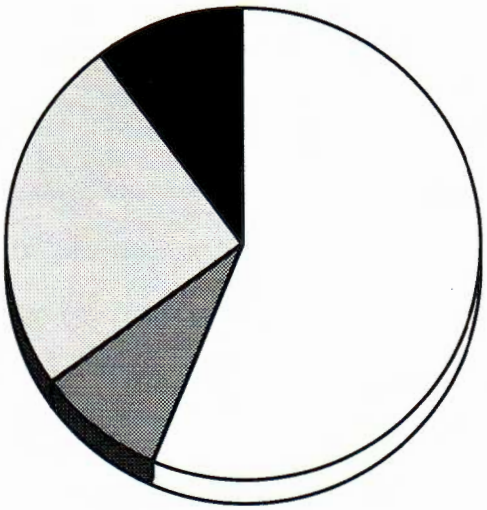
Some examples of collaborative projects (and our partners) include:

- the application of Diffracto Sight for aircraft structures NDI (Diffracto Ltd.);
- the measurement of propellor noise transmission through an aircraft fuselage (BCDD, ISTC);
- aviation security (TC);
- aerial spray drift (OMNR, Forestry Canada, AES, Forest Protection Ltd.);
- trace vapour sensing (DOF, Ag Can, USDA, Swedish University);
- the development of a Phase III flight simulator model for the Dash 8 series aircraft (UTIAS, CAE, deHavilland);
- the study of biospheric phenomena in the Hudson Bay Lowlands (Ag Can, AES, NASA);
- two-dimensional transonic aerofoil testing technology development (Boeing Commercial Airplane Co.);
- wing/propeller slipstream interference study (BCDD);
- as part of the CF-18 International Follow-On Structural Test Program, Mr. Chris Ryder – Senior Principal Research Officer with the Australian Aeronautical Research Laboratory – was seconded to work in the IAR Structures and Materials Laboratory – from September 1990 to March 1991. Mr. Ryder contributed greatly to the CF-18 fuselage spectrum development task.

NATIONAL AND INTERNATIONAL COMMITTEES

Advisory Group for Aerospace Research and Development (AGARD)
Aerospace Industries Association of Canada
American Institute for Aeronautics and Astronautics (AIAA)
American Society of Civil Engineers
American Society for Testing and Materials
ASM International
Canadian Aeronautics and Space Institute (CASI)
Canadian Aerosport Technical Committee
Canadian Association of Composite Structures and Materials (CACSMA)
Canadian Spectroscopy Society (CSS)
Canadian Standards Association
Commonwealth Aeronautical Advisory Research Council (CAARC)
Defence Aerospace Structures and Materials Advisory Committee
Defence Gas Turbine Advisory Committee
Institute of Electrical and Electronics Engineers (IEEE)
International Committee on Aeronautical Fatigue (ICAF)
International Civil Aviation Organization (ICAO)
International Energy Agency (IEA)
Renewable Energy R&D of EMR
Society of Automotive Engineers
Spray Efficacy Research Group (SERG)
Subsonic Aerodynamic Testing Association
Supersonic Tunnel Association
The Technical Cooperation Program (TTCP)
Transportation Safety Board of Canada

REVENUE AND OPERATING BUDGET



	$ MILLIONS
OPERATING BUDGETS, INCLUDING SALARIES	10.8
MINOR CAPITAL	1.7
TRANSFERS FROM OTHER GOVERNMENT DEPARTMENTS	4.75
EXPENDITURES AGAINST REVENUES EARNED	1.95

STAFF

193 CONTINUING FULL TIME

2 RESEARCH ASSOCIATES

13 REVENUE PERSON YEARS AND TERM

108 GUEST WORKERS SIGNED AGREEMENTS, RESULTING IN THE EQUIVALENT OF 51 PY's

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