*Dr. Sundareswara Balakrishna was an outstanding engineer known for his simple, elegant and original engineering innovations. His career spanning six decades was equally shared between two National institutions – National Aeronautical Laboratory (NAL, now CSIR-National Aerospace Laboratories) and the NASA Langley Research Center, USA.*

*In 1960, with a degree in Electrical Engineering, he started his career with Instrumentation & Control (I&C) Division at NAL, Belur. He led a team from his division to design, build and commission Instrumentation & Control Systems for the 4ft. Tri-sonic wind tunnel and other wind tunnel facilities setup at the Belur campus.*

*Beginning of 70s, Instrumentation & Control division moved to systems building in Kodihalli campus. Dr.Balakrishna's interest in Man-machine interaction studies, mathematical modelling of aircraft and pilot dynamics led him to develop flight simulators.*

*Using a fixed base cockpit, he conducted compensatory visual tracking experiments with human operators. Using this experimental data, he developed various pilot models for which he was awarded Ph.D. from Indian Institute of Science, Bangalore.*

*Under an AR & DB Project (1971-76), he developed the first indigenous 3 DOF motion based flight simulator. In Nov.1973, I joined him to contribute with aerodynamic inputs for full flight envelope flight dynamics model of Gnat aircraft. His simple potentiometric sensors were used for the huge linear actuators of motion platform. Cockpit instruments, were realized with gear driven servo-motors driving the needles. Instrument dials were hand painted by me! The flight dynamics model was implemented on ECIL Analog computers which drove the cockpit instruments and the motion platform. In 1976, flight simulator facility was successfully established as per the project proposal.*

*Using the motion simulator, a novel study was conducted to study the effect of motion cues on human pilots in tracking tasks. This resulted in a paper presented in IFAC Conference on Man-Machine Systems held in Sept.1982 at Baden-Baden, Fed.Rep.Germany. Later, it was published in IFAC journal. However, Flight simulator activity was curtailed due to inter-organizational constraints.*

*During early and mid-seventies, Dr.Balakrishna developed control systems for facilities developed at NAL. For the filament winding machine to make cylindrical rocket motors shells, he developed a controller for the pre-preg feed. For the full scale fatigue testing of Gnat aircraft structure, he developed a flight loading System. This became the precursor for the more sophisticated test facility for MiG aircraft.*

*During1978-1981, as a post-doctoral fellow at NASA Langley he worked on modeling temperature control laws for 0.3M Cryogenic tunnel and National Transonic Facility.*

*In 1983, NAL took the responsibility of setting up an Acoustic Test Facility (ATF). Dr.Balakrishna spearheaded the design team and came with a brilliant but unique design of sealing the acoustic chamber. A 120 ton concrete wall with inflatable tarpaulin tubes all around the edges and mounted on railway bogies sealed the chamber. ATF became operational in 1986. Dr.Balakrishna was so satisfied with ATF, he took me and my colleague A.Santaram to ATF and explained the working of the facility.*

*Realizing the need for an experimental facility and a dedicated flight vehicle to study various flight control concepts, he designed a low speed dynamic wind tunnel with inlet guide-vane system to vary tunnel speeds. Using in-house resources, the tunnel was built in Kodihalli campus. It was used to study stability/control characteristics of aircraft configurations and to generate dynamic stability data for missiles developed by*

*DRDL. A novel technique to generate comprehensive longitudinal aerodynamic data using this tunnel formed my Ph.D. thesis at IIT Bombay.*

*He invited Prof.R.B.Damania of IISc to join his division to build a light aircraft. Prof.R.B.Damania joined NAL and built an all composite light aircraft based on Rutan's Long EZ. Mr.D.V.Bakshi's team from Engineering Services played a pivotal role in the fabrication as they had to learn and build. This aircraft named "Light Canard Research Aircraft (LCRA) was ready by end 1986 and had its first flight on 26 Feb.1987. This project gave invaluable experience in fabrication and paved way for light aircraft development program in the division.*

*In 1990, he became the Head of a newly formed Flight Mechanics & Control Division. He formed strong groups in Flight Simulation, Flight controls, System Identification and Experimental Flight Mechanics who went on to make major contributions to national programs.*

*In 1991, he took voluntary retirement and joined Vigyan Res.Inc. through which he worked at NASA Langley Research Center (LaRC). At Langley, though he was closely associated with the National Transonic Facility (NTF), he contributed to the improvement of technical capabilities, efficiency, and safety of all major facilities. NTF being a complex cryogenic tunnel, needed unique technical and operational expertise, which Dr.Balakrishna provided. He has been a cornerstone of the tunnel's success.*

*Few of the unique systems designed, developed and implemented by him for NTF are*

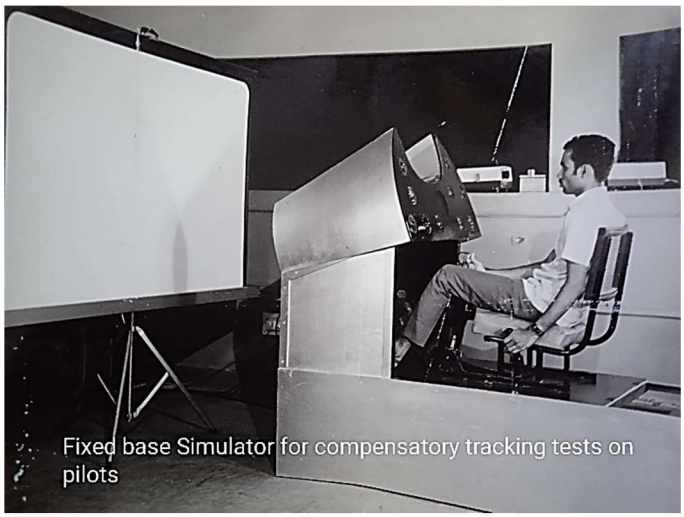
- *Active Balance Damper system, to reduce wind tunnel model aerodynamic-induced vibrations.*
- *Balance Limit Alarm Measurement System to ensure safety of the personnel, strain gauge balance systems, and models tested in the NTF.*
- *Wake strength monitoring system to ensure safety of tunnel and model components.*
- *To improve the tunnel temperature spatial and temporal uniformity which critically affected data quality, he developed control algorithms which in conjunction with proportion control valves, allowed for finer control to realize uniform temperatures.*
- *NTF uses a hot sidewall balance at 100 deg.F. while the tunnel is at -250 deg.F. His "Balance Cavity Recirculation System" to maintain balance accuracy has resulted in excellent data quality in critical tests in recent a Hybrid Wing body evaluation test.*

*In 2015, Dr.Balakrishna received the* ***NASA Exceptional Engineering Achievement Medal for his exceptional engineering contributions to aeronautical exploration goals (High Reynolds Number Transonic Semi-span Test).*** *He designed a new Flight Dynamics Research Facility (FDRF) for the Flight Dynamics Branch of NASA LaRC. This summer, FDRF will become fully operational. He also designed Compressible Aerodynamics Research Tunnel (CART).*

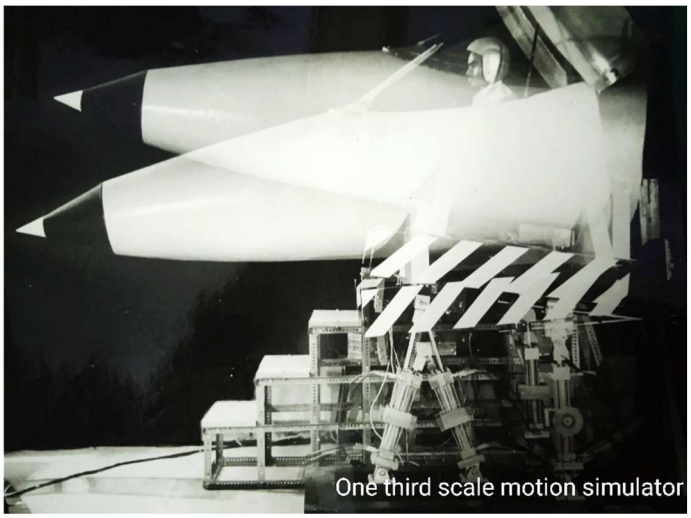
*I worked under him till he left NAL in 1991. He was my guru who initiated and inspired me to become an experimental flight mechanist. He had a unique way of discovering the capability of his scientists and accordingly assigned tasks. The flight simulators and dynamic wind tunnel of NAL no longer exist, but they remain in our memory, reminding that with a will we can achieve!*

*We, his sishyas, colleagues, friends/associates and others whom he inspired through his work miss him. The facilities he designed and built at the two national institutions will always remind us about him and his capabilities.*

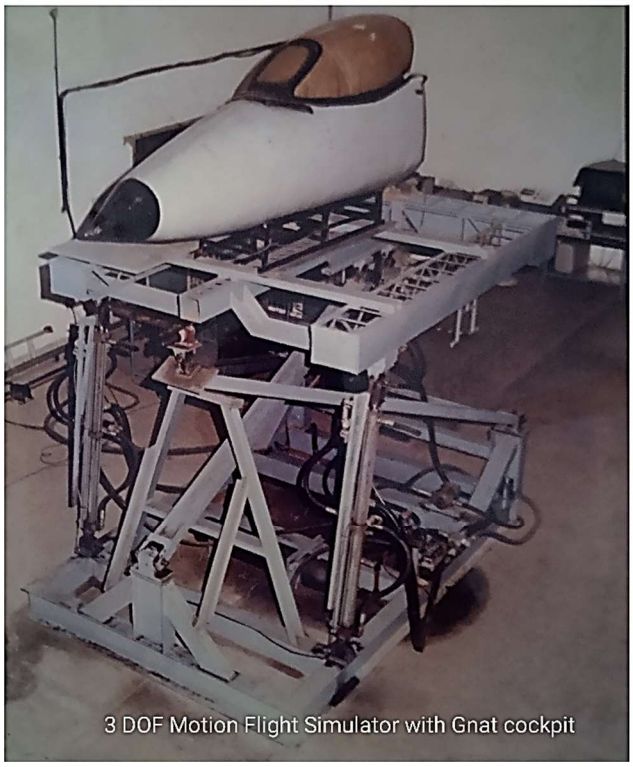
*Dr.M.S.Rajamurthy*
*Former Head, Experimental Flight Mechanics Group*
*Flight Mechanics & Control Division*



Fixed base Simulator for compensatory tracking tests on pilots



One third scale motion simulator



3 DOF Motion Flight Simulator with Gnat cockpit


Light Canard Research Aircraft (LCRA)

Generic aircraft model in Dynamic Wind tunnel

A missile model in the dynamic wind tunnel.