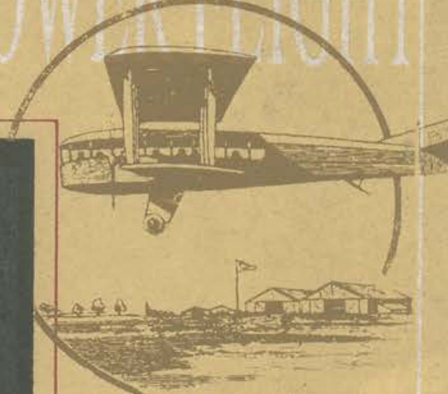
SCIENCE SEMINAR-2003



POWERED FLIGHT: A CENTURY OF INNOVATION & FUTURE OF AVIATION

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BIRLA INDUSTRIAL & TECHNOLOGICAL MUSEUM

NATIONAL COUNCIL OF SCIENCE MUSEUMS · INDIA

West Bengal Students Science Seminar 2003

on

POWERED FLIGHT - A CENTURY OF INNOVATION & THE FUTURE OF AVIATION

Organised by

BIRLA INDUSTRIAL & TECHNOLOGICAL MUSEUM
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DEPT. OF YOUTH SERVICES,
Govt. of West Bengal

FLIGHT VEHICLE POWER PLANT DEVELOPMENT

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Department of Aerospace Engineering I. I. T. Kharagpur

At the beginning of this century, steam and internal combustion engines were in existence but were far too heavy for flight application. The Wright brothers recognized the great future potential of internal combustion engine and developed both a relatively lightweight engine suitable for flight application and an efficient propeller. The power output of internal combustion engines increased from 12 hp to about 4000 hp starting from year 1900 to 1945. The Wright brothers' first aero-propulsion system had a shaft power of 12 hp, and its power/weight ratio was about 0.05 hp/lb. Through the subsequent four decades of evolution, the overall efficiency and the power/weight ratio improved substantially, the latter by more than one order magnitude to about 0.8 hp/lb. This great improvement was achieved by engine design structures and materials, advanced fuel injection, advanced aerodynamics shapes of the propeller blades, variable-pitch propellers, and engine superchargers. The overall efficiency (engine and propeller) reached about 28 percent. The power output of the largest engine amounted to about 5000 hp.

In late 1930 and early 1940s, the turbojet engine came into existence. The new propulsion system was immediately superior to the reciprocating engine with respect to the power/weight ratio (by a factor of 3); however, its overall efficiency was initially much lower than that of the reciprocating engine. The progress was rapid and in less than four decades, the power/weight ratio increased more than 10-fold, and the overall efficiency exceeded that of a diesel propulsion system. The power output of today 's largest gas turbine engine reaches nearly 100,000 equivalent hp.

Impact upon the Total Aircraft Performance

The previously described truly gigantic advancements of stronger and lighter structures and greater aerodynamic quality in aero-vehicles and greatly advanced overall efficiency and enormously increased power output/weight ratios in aero-propulsion systems had a tremendous impact upon flight performance, such as on flight range, economy, maneuverability, flight speed and altitude. The increase of flight speed over the years from 1903 to 1980 has been from 56 km/hr to more that 3218 km/hr. The Wright brothers began with the first human-controlled, powered flight in 1903; they continued to improve their aircraft system and, in 1906, conducted longer flights with safe takeoff, landing and curved flight maneuvers. While the flight speed was only about 56 km/hr, the consequences of these first flights were enormous:

- World interest in powered flight was stimulated.
- The science of aerodynamics received a strong motivation.

- The U.S. government became interested in power flight for potential defense application, especially reconnaissance mission.

In 1909, the Wright brothers built the first military aircraft under government contract. During World War 1, aircraft technology progressed rapidly. The flight speed reached about 240 km/hr, and the engine power attainted 400 hp. After World War 1, military interest in aircraft system dropped, but aircraft technology had reached such a degree of maturity that two nonmilitary application fields could emerge, namely:

- Commercial aviation, mail and passenger transport (first all-metal monoplane for passenger and mail transport, the Junkers F 13, in 1919, sold worldwide)

- Stunt flying leading to general aviation (sport and private transportation)

In the period from 1920 to 1940, the speed increased from about 240 to 560 km/hr through evolutionary improvements in vehicle aerodynamics and engine technology, as discussed previously. At the end of World War 11, the flight speed of propeller aircraft reached about 640 to 720 km/hr, and the engine power output of largest reciprocating engines was about 5000 hp. This constituted almost the performance limit of the propeller/ reciprocating engine propulsion system. Today, the propeller/ reciprocating engine survives only in smaller; lower-speed aircraft used in general aviation.

In the late 1930s, jet propulsion emerged which promised far greater flight speeds than attainable with the propeller or piston engine. The first jet-propelled experimental aircraft flew in the summer of 1939 (the He-178), and in early 1941, the first prototype jet fighter began flight tests (He-280). In 1944, mass-produced jet fighters reached a speed of about 885 km/hr (Me-262).

In the early 1950s, jet aircraft transgressed the sonic speed. In the mid-1950s, the first supersonic jet bomber (B-58 Hustler) appeared, and later years of military development, gas turbine technology had reached such a maturity that the following commercial applications become attractive:

- Commercial aircraft, e.g. Comet, Caravelle, and Boeing 707

- Surface transportation (land, sea)

- Stationary gas turbine

In the 1960s, the high-bypass-ratio engine appeared which revolutionized military transportation (the C5A transport aircraft). At the end of the 1960s, based on the military experience with high-bypass-ratio engines, the second generation of commercial jet aircraft came into existence, the wide body aircraft. An example is the Boeing 747 with a large passenger capacity of nearly 400. Somewhat later the Lokheed L-1011 and Douglas DC10. By that time the entire commercial airline fleet used turbine engines exclusively. Advantages for the airlines were:

- Very high, overall efficiency and consequently, long flight range with economical operation

- Overhaul at about 8 million 45 thousand Kilometers

- Short turnaround time

- Passenger enjoyment of the very quiet and vibration-free flight, short travel time, and comfort of smooth stratospheric flight

- Community enjoyment of quiet, pollution-free aircraft

By the end of the 1960s, the entire business of passenger transportation was essentially diverted from ships and railroads to aircraft. In the 1970s, the supersonic Concorde with a flight speed of 2400 km/hr (the third generation of commercial transport) appeared with an equivalent output of about 100,000 hp.

FUTURE DEVELOPMENT OF JET PROPULSION SYSTEMS

Major advancement of air-breathing jet propulsion systems can be expected from

- Evolutionary improvements of the established large-bypass-ratio turbofan engines for transonic flight speeds and low-bypass ratio turbofan, or pure turbojet engines, for supersonic flight speeds.

- Improvements and new approaches to engine-airplane integration

- New approaches to air-breathing propulsion systems for high supersonic and hypersonic flight speeds

The evolutionary improvements of established engine types will result in greater fuel economy and better performance characteristics. By the end of the century, one can expect polytropic efficiencies of turbine and compressor of nearly 95 percent. Furthermore, one will see considerably increased single stage pressure ratios; significantly higher turbine inlet temperatures resulting from better heat and oxidation- resistant materials, and more effective blade cooling methods; and much lighter structural designs and materials (composite materials). This technological progress may result in an overall engine efficiency increase of about 20 percent and in a weight reduction for given horsepower output by probably a factor of 2 and higher.

For the evolution of high-bypass ratio engines at cruise speeds between 800 to 960 km/hr, following trend is important; the greater the turbine inlet temperature and the higher the polytropic efficiencies of the compressor and turbine, the higher the optimum pressure ratio of the gas turbine engine and the bypass ratio of the fan. In the future, this trend will lead to larger bypass ratios; hence, the fan shroud will become relatively large in diameter and will contribute substantially to the weight and drag of the propulsion system. Several solutions are proposed:

- Using an fan, having a high solidity of swept-back fan blades, also called a prop-fan. This configuration is currently in an experimental state and may become very important in the future for improving fuel economy.

- Transonic airframe configuration in which the large fan shroud have a dual function: one to contribute towards the stability of the aircraft (horizontal and vertical stabilizer surfaces), second serving as a shroud for the fan.

Supercritical airframe configuration is capable of extending a high lift/drag ratio at near sonic speed. The bypass ratio for such configuration at these relatively high speeds would be substantially lower than that for flight speeds around 800 km/hr and therefore, a shrouded fan would be most applicable.

The aircraft lift/drag ratio-is decreased with the increase of Mach number, while the overall efficiency of aero-propulsion systems increases with increasing flight Mach number. So, if lift/drag ratio of supersonic aircraft is decreased to about 2:1 (for supersonic Concorde is about 3:1), and the structural weight is greatly improved, the supersonic passenger transport will be economically feasible.

The air-breathing propulsion systems with combined ram compression and turbo compressor are useful up to flight Mach numbers approaching 3. When flight Mach number exceeds about 3.5, there is no advantage of turbo compressor. So, in the range of flight mach numbers from 3.5 to 5, pure subsonic combustion ramjet engine is the most suitable. Beyond flight mach numbers of about 6, the pressure and temperature ratios would be unfavorably high if the engine continued to operate as a subsonic combustion ramjet. The reasons are:

- High degree of dissociation of the combustor exhaust flow, reducing the energy available for exhaust velocity

- Pressure far too high for Brayton cycle operations or for the structure to withstand

For these reasons the cycle will be changed from a subsonic to a supersonic combustion ramjet, and hydrogen fuel will be used because hydrogen has the greatest

- Combustion heat and fuel-air concentration range

- Diffusion speed and reaction speed

- Heat-sink capabilities

This supersonic combustion ramjet is characterized by a reduction of the undisturbed hypersonic flight Mach number to a somewhat lower hypersonic Mach number with an increase in entropy, which should be as low as possible. The deceleration process must be chosen in such a manner that the increases in static pressure and entropy correspond to a high-performance Brayton cycle. The internal thrust generated by the exhaust gas must be larger than the external drag forces on the vehicle.

To minimize the parasitic drag of the ramjet vehicle systems, various external rainjet vehicle configurations have been suggested. However, theoretical and experimental investigations will be necessary to explore their associated aero-thermo-chemical problems. For experimental research, one may consider investigations using free-flight models or hypersonic wind tunnels with true temperature simulation.

A participant delebrating at the West Bengal Students Science Seminar 2002 held at BITM

REMOTE SENSING APPLICATIONS FOR NATIONAL DEVELOPMENT : POTENTIAL & IMPEDIMENTS

Soham Bhattacharya, Ramakrishna Mission Vidyapith, Vivekanandanagar, Purulia
1st Prize winner of the West Bengal Students Science Seminar 2002

Respected judges and assembled audience,

Arthur Clarke once said 'The only way of finding limits to the possible is by goading them into the impossible'. Staying well within the firm bounds of science and technology and venturing but cautiously into the realm of science fiction we will see how giant stepping stones are being erected one after another.

One such giant stepping-stone was erected with the invention of artificial satellites. Right from the early days of artificial satellites, the potential of these space platforms for earth observations was clearly recognized. Moreover, the high vantage point of the satellites has enabled coverage of large areas of earth in only a few days. This sensing of an object from a distance in what we mean by *remote sensing*.

The term 'remote sensing' in wider sense may be defined as the acquisition and measurement of data on some properties of a phenomenon by a recording device not in physical intimate contact with the features. Here measurement is done by using electromagnetic radiation with the help of acoustic energy employing cameras, lasers, frequency radio receivers, radar systems, sonar and other instruments. Remote sensing satellites are generally deployed in polar sun synchronous orbits, which allow them to photograph different parts of the earth under similar conditions of solar illumination. In present day multi-spectral imaging is done, to bring a lot of latent information not available in ordinary photographs.

Now comes the question 'How remote sensing is done?' Well! It must be made clear that aircrafts, balloons and towers can do remote sensing. But satellite based remote sensing are much in vogue in present days. The various stages of satellite-based remote sensing are discussed here:

i) First a source emits electromagnetic radiation from a transmitter fixed in the sensor.

ii) Secondly, the electromagnetic energy is transmitted from the source to the surface of the earth.

iii) Thirdly, the interaction of energy with the atmosphere takes place. Electromagnetic energy while passing through the atmosphere gets scattered and absorbed by various gases particles after which interaction of energy with the ground surface takes place.

iv) Fourthly, the electromagnetic energy is transmitted back to the sensor and its detection is done by converting it into electrical output.

v) Lastly the data are collected and processed into computer compatible magnetic tapes (CCTs) or photographs. They are then visually or digitally interpreted from which we can get various thematic maps and other resources.

Now onto the applications

During the past two decades remote sensed data have been exclusively used in non-renewable resources such as geology. Their application in renewable sources has shown its usefulness in land based related issues such as agricultural & forest resources, water resources, land use and mapping.

The foremost application of remote sensing is in the field of land and mapping. Cartographic mapping and map updating, categorization of land capability and separation of rural and urban categories are few of the characteristics of remote sensing applications in this field. The wasteland mapping of more than 146 districts of India is covered in just over one year with the active assistance of remote sensing tools.

It has also helped in the development of the geological dept. among which recognition of rock types, delineation of unconsolidated rocks and mapping of igneous rocks deserve special attention.

Moreover, it has also contributed to agricultural and forest resources. Measurement of crop acreage by species, determination of soil conditions and detection of forest fire has enabled proper natural resource management possible. Remote sensing applications have found an important place in the National Mission of Drinking Water technology. It has enabled knowing of various oceanographic facts. It has helped in the detection of pollution prone areas. Remote sensing satellites with its spying features have enhanced the immunity of India. It has enabled weather forecasting.

My dear audience, don't you feel proud to learn that India is one of the six countries of the world having its own remote sensing satellites for weather forcasting?

This in brief is the potential remote sensing application. Now let us have a look at the Indian scenario. Since the establishment of earth station at Shadnagar near Hyderabad, India has built up a vast infrastructure of manpower for interpreting, analyzing and processing of remote sensed pictures. After the launching of first remote sensing satellite on 17 March 1988, India has launched as many as eight remote sensing satellites, the last being launched in 1999, IRS-P4. The two forthcoming satellites, which are to be launched by India, are IRS-P6, which is to be launched this year and IRS-CARTOSAT 2, which is to be launched in 2004.

Recently, it was announced that the United States under one of its programme of supporting two or three centres of excellence has chosen Dehradun Institute to cover this field of remote sensing. The five regional remote sensing service centres of India are in Kharagpur, Nagpur, Jodhpur, Dehradun and Bangalore. The other institutions where both educational and training aspects are covered are Anna University, Chennai, NRSA Hyderabad, SAC Ahmedabad & Regional Remote Sensing Server Bangalore. Besides Roorkee University, Kharagpur IIT and Mumbai IIT provide graduate & post graduate courses on remote sensing applications.

In any technological endeavour and development, the application aspects always take time to catch up. So far as India is concerned, it is particularly so in the case of remote sensing applications.

The latest satellite launched by United States has emerged with space resolution data capable of discerning objects just within 1 m. But unfortunately India has achieved space resolution only upto 5.8 m. India being a third world country, it cannot provide the required infrastructure needed for the development in this field. Moreover, our Government is in no such position to invest lot of money in it. The need is to involve more and more non-government and research sectors that would bear the necessary investment.

Friends! Just look at India, a cradle of culture, wisdom and intelligence. But will India remain in that cradle forever? It is time for us to get down from the cradle, holding the hands of remote sensing technology and walk our way to the threshold of science wherefrom a beaconing light seems to be approaching. Yes Light! Light of Hope! Light of Development! Light of prosperity and glory.

One of the participants of the seminar receiving his award from Mr. Anisur Rahaman, Minister-in-charge, Dept. of Animal Resources Development, Govt. of West Bengal.

REMOTE SENSING APPLICATIONS FOR NATIONAL DEVELOPMENT : POTENTIAL & IMPEDIMENTS

Rituparna Dutta, Raigunj Girls' H. S. School, Uttar Dinajpur
Best Girl participant of the West Bengal Students Science Seminar 2002

Remote Sensing is the technology of acquiring useful information of any remote object without having actual contact with it. It is based on the principle of reflection of Electro magnetic radiation. By sensing and analyzing the reflected Electro magnetic radiation, much valuable information about the object can be obtained. In the Remote sensing system both active and passive sensors are used.

The whole process of remote sensing system consists of the following seven steps: -

A) Energy Source- The required Electro magnetic radiation is obtained from a natural source such as sunlight or produced artificially such as radio-wave and microwave.

B) Propagation through atmosphere- Electro magnetic wave from the energy source passes through the atmosphere towards the target. While passing through the atmosphere there occurs various interactions. These interactions may take place a second time as Electro magnetic wave travels from the target to the sensor.

C) Interaction with the target- Once the energy strikes the target various interactions occur depending on the properties of both the target and the radiation.

D) Sensor- The reflected Electro magnetic wave from the target is collected and recorded by a sensor usually placed in a remote Satellite.

E) Transmission, Reception and Processing- The energy recorded by the sensor is then transmitted in Electronic form to a receiving and processing station where the data is processed into image.

F) Interpretation and Analysis- The processed image is interpreted either digitally or electronically to get useful information about the object under study.

G) Application- The final element of remote sensing is achieved when we apply the information obtained from the image to understand the object better, reveal some new information or assist in solving a particular problem

Electro magnetic spectrum

Electro magnetic spectrum ranges from the shorter wavelength such as x-ray to longer wavelength such as microwave and radio wave. There are several regions of Electro magnetic spectrum which are usually used for remote sensing, Mainly Ultraviolet ray, Infrared

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ray and radio waves are used for remote sensing.

With the help of remote sensing technology, valuable information about the land, rivers, oceans and forests on the earth can be obtained.

Applications

Now let me discuss about the application of this system in the field of agriculture and forestry. Increasing population, poverty and malnutrition are the main problem of the under-developed as well as developing countries. Only seven percent of the earth's surface is available for agriculture. Proper utilization of this land area by efficient planning and agricultural management is possible with the help of remote sensing information. Remote sensing system provides unique and timely information about the soil texture, water and nitrogen content of soil and helps to select the right soil for the right crop. In this way better crop production is assured. Another related component has recently began to immerge in the form of individual crop forecasting as for example, for sugar beat and potato allowing a complex market for such crops to develop. The premier way of acquiring data like food movements, pricing, imports or exports in a cost effective way is possible through the efficient use of remote sensing methods.

Remote sensing system keeps constant vigil on the forest areas and can help us to prevent massive deforestation. Drought and floods are common phenomena in our country and deforestation is an important cause behind it. By using remote sensing technology, deforested areas can be easily located and proper measures can be taken to preserve the forest. By giving valuable information about the riverbeds and forecasting flood in a particular area, we can help the local authority to take appropriate measures. Remote sensors also send regular weather forecast, which is very helpful for the farmers, fishermen, miners and navigators.

By utilizing remote sensing- fishery, shipping industry and other coastal industry can be immensely benefited. Densely populated areas of fish in the sea or river can be located with this system, helping easy fishing. Total quantity of regional Plankton in an area of sea or ocean can be measured with great accuracy. Nature, exact location and direction of movement of iceberg in ocean are constantly monitored by the remote sensors and helping the ships safe navigation. This technology is also useful to prevent environmental pollution. Radioactivity and density of polluting gas in the environment can be monitored with the help of this system.

Density of snow on the mountains is monitored accurately. Remote sensing data are utilized for mapping a region, which may be helpful to locate underground natural gas and oil, coal and other mineral resources.

Remote sensing satellites are efficiently employed to explore the water for irrigation purposes and underground water levels in different areas. Traditional applications have been in earth resources mapping and frequent environmental monitoring in the inaccessible regions of the world.

Videography is another form of remote sensing, which is utilized now a days.

Remote sensing applications in India

To explore the natural resources, the use of remote sensing technology plays an important role in developing countries like India. National Remote Sensing Agency (NRSA) in Hyderabad and Centre of Studies in Resource Engineering (CSRE) in Mumbai are engaged in the research of Remote Sensing. In 1988, India first launched its Remote Sensing Satellite IRS- IA. Subsequently, IRS-IB, IRS-P2, IRS-IC, IRS-P3, IRS-P4, IRS - P5 were launched. Indian Remote Sensing Satellites are constantly watching and sending necessary instructions regarding the Soya bin cultivation in Madhya Pradesh and cotton yield in Tamilnadu.

NRSA has pointed out drinking water resources in 446 districts of our country. By using this technology NRSA gave instructions to Indian Oil Corporation Ltd. about the shortest route for laying oil pipe line, which helped I.O.C. to save about thousand of crores of rupees.

Remote sensing satellites are regularly giving information regarding the natural resources like coal, mineral oil, natural gas and other mineral resources. Diamond mine has been found in the district of Bastar in Madhya Pradesh.

Though Remote Sensing Technology has immense importance, some problems may also be faced. The secrecy and privacy of a country particularly in the matter of Defenses may not be maintained. The Remote sensing system itself may augment the environmental pollution. Excessive use of microwaves may cause health hazards. The tremendous cost of this system may be unbearable for the developing countries.

Although the developed countries randomly use remote sensing technology, it is still beyond the reach of many developing and under developed countries. But let us be optimistic that in near future most of the countries on this earth will take the advantage of this wonderful technology to enrich themselves.

One of the participants receiving her awards from Mr. Anisur Rahaman.

WINNERS OF WEST BENGAL STATE LEVEL SCIENCE SEMINAR – 2002

BEST PARTICIPANT

Soham Bhattacharya	R K M Vidyapith,	PURULIA

MERIT PRIZE

Rajdeep Konar	Siksha Shastra Vishwabharati	Birbhum
Rituparna Dutta	Raigunj Girls' High School	North Dinajpur
Tamal Chandra	Kharagpur S. J. High School	Midnapore (W)
Sourav Ranjan Thakur	The Atreyee Eng. Medium H. School	South Dinajpur
Trisha Roy	Julian Day School, Kalyani	Nadia
Rudrani Chattoraj	St. Joseph School, Matigara	Darjeeling

DR. RAMATOSH SARKAR AWARD FOR BEST PARTICIPANT

Soham Bhattacharya	R K M Vidyapith,	PURULIA

SHARMILLA MUKHERJEE TALENT AWARD FOR BEST GIRL PARTICIPANT

Rituparna Dutta	Raigunj Girls' High School	North Dinajpur

One of the participants deliberating in the West Bengal Students Science Seminar, 2002

SUBJECTS OF SCIENCE SEMINAR SINCE 1968

The Students competitive Science Seminar was started by BITM in 1968 and has been taken as one of the Museums regular educational activities. The seminars are organised in Block, District and State levels in West Bengal and other States of the country. Attractive prizes in the form of popular scientific books are awarded to the winners to encourage the participants in choosing the subjects of the seminars, its relevance in the context of prevailing social and economic problems as well as scientific events are always considered. The following is the list of topics selected for Seminars between 1968 and 2003.

YEAR	SUBJECT
1968	a) Revolution in Agriculture
	b) Transplantation of human body
	c) Generation of Electric Power
1969	a) Journey to moon
	b) Exploration of space – how it helps mankind
1970	a) Origin of Universe
	b) Probing of Outer Space
1971	a) Speed more Speed
	b) Water and Air Pollution
1972	Plants for further Industrial Growth of your District
1973	Important Discoveries in Astronomy
1974	Atom for Peace
1975	In the opinion of the house Space Exploration is Waste
1976	In a quest for New Sources of Energy
1977	Important Discoveries in Astronomy
1978	Life and Works of Albert Einstein
1979	Science – a Boon or a Curse for Children
1980	Solar Eclipse – 1980
1981	Renewable Sources of Energy
1982	Space & Mankind
1983	Communication – Today and Tommorrow
1984	Environment and Human Survival
1985	We and the Ocean

1986	Green Revolution and our Future
1987	Pollute and Perish – Conserve and Flourish
1988	Information Revolution
1989	Atomic Energy – Potential and Hazards
1990	Natural Disaster : Man – Slave or Master
1991	Origin of Life
1992	Tomorrows Habitat
1993	Are we alone in the Universe?
1994	Population : A Resource or A Burden?
1995	Resources from the Earth
1996	Genetic manipulation – Scope, Potential and Impact
1997	Recycling – Steps towards conservation
1998	50 years of Science & Technology in independent India – Achievements and Aspiration
1999	Science & Technology in the New Millennium – Prospects and Problems
2000	Health for All : Vision & Reality
2001	Biotechnological Revolution: Benefits & Concerns
2002	Remote Sensing Applications for National Development - Potential & Impediments
2003	Powered Flight - A Century of Innovation & the Future of Aviation

STATISTICS OF THE STUDENTS SCIENCE SEMINAR 2002 IN WEST BENGAL

	No. of seminars	No. of participants		Audience present during Seminar		
		Students	Schools	Students	Teachers	others
Block level Seminars	318	3180	1500	16500	2500	8500
District level Seminars	16	950	650	1600	750	1500
State level Seminar	1	32	32	200	50	20

PARTICIPANTS LIST OF WEST BENGAL SCIENCE SEMINAR - 2002

	NAME	SCHOOL	DISTRICT
1.	Abhishek Banerjee	Bajora High School	Bankura
2.	Amit Kr Sinhababu	Siksha Satra Sreeniketan	Bankura
3.	Rajdeep Konar	Siksha Sastra Vishwabharati	Birbhum
4.	Arpita Banerjee	Rampuhat Girls' High School	Birbhum
5.	Minakshi Sarkar	Andal Girls' High School	Barddhaman
6.	Debraj Roy	Guskara P. P. Institution	Barddhaman
7.	Dipanjan Bose	Mathabanga High School	Coochbihar
8.	Jesmir Rehman	Pundibari Girls' High School	Coochbihar
9.	Rudrani Chattoraj	St, Joseph School, Matigara	Darjeeling
10.	Mainak Chakraborty	Banimandir Rly. H. S. School	Darjeeling
11.	Diptyapriya Mazumdar	Dihibagnan K. B. Roy H. S. School	Hooghly
12.	Anamika Patra	Seakhala Banimadhav Girls' School	Hooghly
13.	Anwesha Chowdhury	Madarda Girls' High School	Howrah
14.	Satyabrata Maity	Jhorhat Fakir Ch. High School, Andul	Howrah
15.	Priyanka Roy	Patipukur Girls' High School	North 24 Pgs
16.	Swayam R. Halder	Ranaghat Anchal H. School	North 24 Pgs
17.	A. Lakshmi	National High School For Girls	Kolkata
18.	Sourish Roy	The Frank Anthony Public School	Kolkata
19.	Ankita Das	Hindu Girls' School (H. S.)	Midnapur (E)
20.	Sayantani Nanda	Hindu Girls' School (H. S.)	Midnapur (E)
21.	Tamal Chandra	Kharagpur S. J. High School	Midnapur (W)
22.	Debabrata Mishra	Turka H. School (H. S.)	Midnapur (W)
23.	Soham Bhattacharya	R. K. Mission Vivekanandanagar	Purulia
24.	Soumitra Kapri	Sainik School	Purulia
25.	Kaushik Mandal	Ganipur High School	South 24 Pgs
26.	Moumota Das	Budge Budge Uchha Valika Vidyalaya	South 24 Pgs
27.	Rituparna Dutta	Raiganj Girl's High School	Dinajpur (N)
28.	Mousami Mallik	Hemtabad A. H. School	Dinajpur (N)
29.	Apurba Das	Balurghat Khadimpur High School	Dinajpur (S)
30.	Saurav Ranjan Thakur	The Atreyee Eng. Medium H. School	Dinajpur (S)
31.	Arpa Biswas	Santipur Municipal High School	Nadia
32.	Trisha Roy	Julien Day School, Kalyani	Nadia

WEST BENGAL STUDENTS SCIENCE SEMINAR WINNERS SINCE 1980

Year	*Name of Participant*	*School/District*
1980	Sri Indranil BISWAS	Sainik School, PURULIA
1981	Shri Indranil BISWAS	Sainik School, PURULIA
1982	Shri Kaushik SARKAR	R.K.M. Vidyapith, PURULIA
1983	Shri Kaushik MUKHERJEE	Patha Bhawan, Shantiniketan, BIRBHUM
1984	Shri Paramita MUKHERJEE	St. James (H) School, Binnaguri, JALPAIGURI
1985	Shri Saibal GIRI	R.K.M. Vidyapith, PURULIA
1986	Shri Badsah MUKHERJEE	R.K.M. Vidyapith, PURULIA
1987	Smt: Sudipta MUKHERJEE	Jodhpur Park Girls, High Schools, KOLKATA
1988	Smt. Kakali BANERJEE	R.K.S.M. Sister Nivedita Girls School, KOLKATA
1989	Shri Samrat MUKHERJEE	Marry Imaculate School, MURSHIDABAD
1990	Smt. Sushmita CHOWDHURY	R.K.S.M. Sister Nivedita Girls School, KOLKATA
1991	Smt. Panchali BASU	St. Joseph School, Siliguri, DARJEELING
1992	Smt. Debarupa DAS	R.K.S.M. Sister Nivedita Girls School, KOLKATA
1993	Shri Anindya BASU	R.K.M. Vidyapith, PURULIA
1994	Smt Ananya GHOSAL	R.K.S.M. Sister Nivedita Girls School, KOLKATA
1995	Shri Rohan DEBROY	R.K.M. Vidyapith, PURULIA
1996	Shri Tanmoy CHOWDHURY	R.K.M. Vidyapith, PURULIA
1997	Shri Sumana KHAN	Kangsabati Sishu Vidyalaya, BANKURA
1998	Smt. Subhra MUKHERJEE	Palashi Hemangiri Sarojini Vidyamandir, HOOGHLY
1999	Miss Aishee SENGUPTA	Patha Bhavan, KOLKATA
2000	Shri Subhonmesh BOSE	Saltlake English Medium School, KOLKATA
2001	Shri Somdev SIL	R K M Vidyapith, PURULIA
2002	Shri Soham BHATTACHARYA	R K M Vidyapith, PURULIA

1978-2003

FOREWORD

The first practical powered airplane capable of controlled flight was built and flown in the United states in 1903. History was made on 17th December, 1903 when Wilbur and Orville Wright sucessfully piloted three flights in the Kill Devil Hills near Kitty Hawk, North Carolina. The best being of 59 seconds only with Wilbur as the pilot. Nevertheless, this triggered off one of the major achievements of mankind which changed the concept of exploration, travelling, transportation and communication. Chains of improvement in design, engineering and technology has made powered flight the most important part of our lifestyle and now, in 2003, we have landed to the centenary year of this great achievement.

Keeping in mind the importance of the subject and making the students of our country aware of it, National Council of Science Museums have chosen "Powered Flight - A Century of Innovation & the Future of Aviation" as the topic for the National Science Seminar 2003.

National Council of Science Museums organizes this country wide competitive Science Seminar every year for students reading upto class X. Thousand of students from Ladakh to Kanyakumari including Lakhsadweep, Andaman & Nicobar Island deliberate on an important topic chosen after detailed discussion with eminent scientists and educationists. Also a few lakh have the opportunity to listen to the deliberations. This activity of N.C.S.M. has proved to be one of the most effective methods for popularization of science amongst the masses and provides an opportunity for participants to know about a new subject which is relevant to human life but not included in their syllabus.

As a part of this nationwide event, Birla Industrial & Technological Museum, an unit of N.C.S.M. have organized the Students Science Seminar on "Powered Flight- A Century of Innovation & the Future of Aviation" in all the nineteen Districts of West Bengal in collaboration with Youth Service Department, Govt. of West Bengal during August 2003. Two best speakers of the district level seminars will now participate in the West Bengal Student Science Seminar on 30th August, 2003 at BITM. The best speaker in this seminar will represent the state in the National Level Seminar to be held at New Delhi on 11th October, 2003.

Samaresh Goswamy
Director
Birla Industrial & Technological Museum

PROGRAMME

WEST BENGAL STUDENTS' SCIENCE SEMINAR 2003

Topic: Powered Flight - A Century of Innovation & the Future of Aviation

Inaugural Function *on Saturday, 30th August, 2003 at 11 a.m.*

Inauguration by : **Md. Salim**, Minister-in-charge, Depts. of Youth Services, Minorities, Development & Welfare, Self Employment Scheme for the Urban Unemployed, Govt. of West Bengal.

Guest-of-Honour : **Shri B. K. Menon**, Chairman & Managing Director, Hindustan Copper Limited

President : **Prof. A. K. Barua**, Padmashree and Project Director, Energy Research Unit, Indian Association for the Cultivation of Science.

11 .00 am	:	Inaugural Function
11 .30 am	:	Ist Session
01 .00 pm	:	Recess
01 .30 pm	:	2nd Session
05 .00 pm	:	Valedictory Programme

Valedictory Function *on Saturday, 30th August, 2003 at 5 p.m.*

Chief Guest : **Shri Supriya Das Gupta**, Vice Chairman cum Managing Director, M. N. Dastur & Company (P) Ltd.

Md. Salim, Minister-in-charge, Depts. of Youth Services, Minorities, Development & Welfare, Self Employment Scheme for the Urban Unemployed, Govt. of West Bengal speaking in the inaugural programme of the West Bengal Students Science Seminar, 2002

PRIZES

PRIZES FOR THE STUDENT'S SCIENCE SEMINAR 2002

1st Prize: 1 No. Rs. 1000 in forms of books

Merit Prizes: 6 Nos. Rs. 500 each in books

Dr. Ramatosh Sarkar Award for best participant : Rs. 1000 in cash

(Awarded by Smt. Dipti Sinha, one of his beloved student)

Sharmila Mookerjee Talent Award for the best girl participant : Rs. 250

(Awarded by Prof. S. Mookherjee)

Mr. Anisur Rahaman, Minister, Dept. of Animal Resources Development, Govt. of West Bengal speaking in the valedictory function of W. B. Students Science Seminar 2002.

Inertial Guidance for Vehicles

Dr. A.K. Chattopadhyay

Professor & Head Mechanical Engineering Department B.E.College (D.U.), Howrah

Inertial-guidance systems for vehicles consist of gyroscopes that are basically the position measuring or indicating devices. The accuracy with which the gyroscopes indicate the position of a vehicle will ultimately determine the controllability of the vehicle to maintain its desired trajectory.

Fig.-I shows a gyroscope, which consists of a spinning disc (gyro wheel) supported by linkages called gimbals. The axis of rotation of the gyro wheel is called the rotor spin axis. Axis y of the Fig.-I represents spin axis.

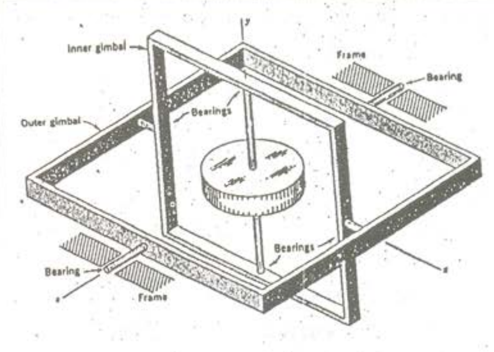

Fig.1 Free gyroscope

There are many types of gyroscopes viz., free gyros, vertical and directional gyros, restrained gyros, integrating and rate gyros etc. of which a few will be briefly described below for gaining insight into the operation of inertial-guidance systems.

Free Gyros : The term 'free gyro' describes a gyro wheel, which is suspended in such a manner, that external torques cannot be transmitted to it. The gimbals of free gyro (Fig. 1) are supported on bearings so that the direction of the spin axis tends to remain fixed in space regardless of the motion of frame.

This tendency of the rotor spin axis to maintain a fixed direction in inertial space is depicted in Fig.2. Initially, the spin axis of this gyroscope is perpendicular to the earth (Fig.2a). If the vehicle in which the gyroscope is mounted is stationary relative to the earth (i.e. remains at point A, which is fixed), in 3 hr. the earth turns 45^0. Thus, in 3 hr., the angle of inclination of the spin axis is 45^0 with respect to the earth, as shown in Fig.2b. The gyroscope is still located at point A, and its rotor spin axis has not changed direction in inertial space. The angle of inclination is due to the earth's rotation in space. After 6 hr, the spin axis is tangent to the earth (Fig.2c).

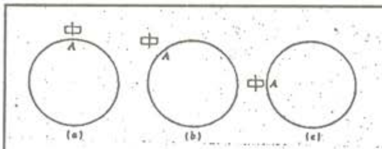

Fig.2 Relative motion of earth with respect to rotor spin axis

However, in a practical gyro, the spin axis tends to drift slowly from its initial direction because of torque acting on the gyro wheel due to friction in the gimbal bearings. It should, however, be noted that the angle of inclination of the spin axis w.r.t. the earth depends not only on the rotation of the earth and drift but also on the movement relative to the earth of the vehicle in which the gyroscope is mounted.

Vertical and Directional Gyros : When the spin axis of a gyroscope is parallel to the gravitational field of the earth (i.e. perpendicular to the earth's surface) it is said to be a vertical gyro. Resetting the reference position of the spin axis is necessitated to compensate for the effects of drift, earth's rotation, and motion of the gyroscope relative to the earth.

Applying an external torque to realign the gyro wheel to the desired reference position normally does this. An external torque can be applied to the gyro wheel shown in Fig.1 by extending the gimbal axis and connecting torque motors to these shaft extensions (Fig.4). In this arrangement the rotor of the torque motor is wound around the shaft extension and is free to rotate inside its stator fixed to the adjoining gimbal or frame. An electrical signal applied to the torque motor causes a torque to be applied on the extension of the shaft.

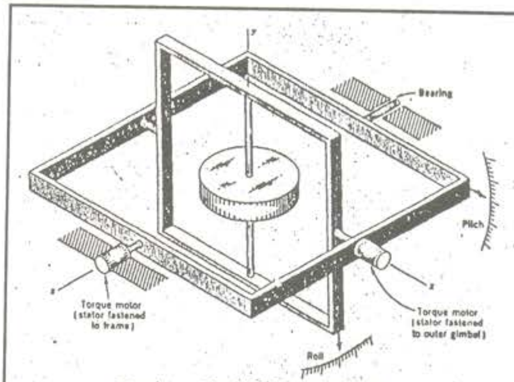

Fig.4 Vertical gyroscope

A directional gyroscope is one in which the spin axis lies in a horizontal plane and holds a given direction, which is usually north south. A directional gyroscope may be slaved to a magnetic compass, which provides the primary north-south (N-S) reference. By maintaining the spin axis in some reference direction, it is then possible to measure the angular displacement of the frame (i.e. the angular displacement of the vehicle to which the frame is mounted). Gyroscopes used to measure such displacements of a vehicle from a reference direction, like vertical or N-S orientation, are frequently referred to as displacement gyroscopes.

A vertical gyroscope can measure pitch and roll, while a directional gyroscope can measure yaw (Fig.3). It is worthwhile to mention here that pitch is the angular motion about the lateral, or z-axis, roll is the angular motion about the normal, or y- axis. Fig.4 shows the frame and the pitch and roll scales of the vertical gyroscope fastened to the vehicle.

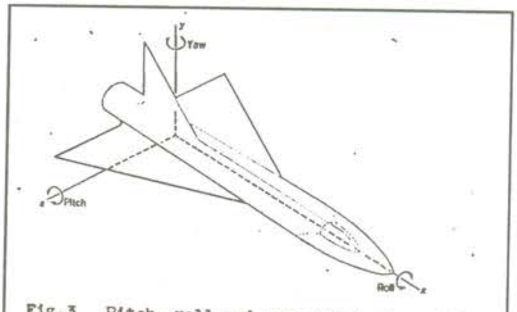

Fig.3 Pitch, roll and yaw motion of a vehicle

A rotation of the vehicle about the x, y, or z-axis causes a corresponding rotation of the frame and the attached pitch and roll scales. A rotation of the vehicle about the z-axis causes a corresponding rotation of the pitch scale, but the outer gimbal and attached pointer cannot rotate about the z axis, because the spin axis is maintained in a vertical position. Thus, the relative motion between the pitch scale, which rotates with the vehicle, and the pointer on the outer gimbal is a measure of the angle of inclination, or pitch, of the vehicle. The pointer and the scale may be replaced by our electrical pick-off in order to obtain a voltage signal proportional to the pitch angle. This change in pitch also causes the roll scale to rotate about the z-axis, while the inner gimbal remains fixed. But, there is no change in the scale reading as this motion is perpendicular to the pointer on the inner gimbal. For a rotation about the x axis the roll scale rotates relative to the pointer on the inner gimbal, which maintains its vertical inclination. This relative motion gives the measure of the roll. The pitch reading is unaffected as both the outer gimbal and the pitch scale rotate the same amount, and no relative motion persists. Similarly, a motion of the vehicle about y-axis (i.e. yaw) has no effect upon either the roll or the pitch readings.

For the directional gyroscopes shown in Fig.5, the rotor spin axis maintains a fixed horizontal direction (usually N-S). A rotation of the vehicle about the y-axis causes a corresponding rotation of the attached yaw scale. But, the outer gimbal and attached pointer cannot rotate, as the spin axis is maintained in its reference direction. This relative motion is thus a measure of yaw. Other motions have no effect on the measured angle of yaw. Vertical and directional gyros are, therefore, used in automatic pilots, roll stabilizing equipment, inertial-navigation equipment etc.

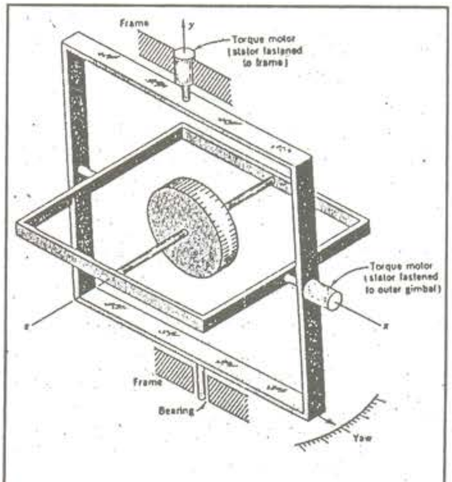

Fig.5 Directional gyroscope

Restrained Gyros : A restrained gyro is one, which has constraints such as springs or dampers attached to the gimbals in such a manner, that a motion of the gimbal tends to precess the gyro.

Rate Gyros : A rate gyro is one in which the motion of a gimbal is restrained by means of springs, when the frame rotates about the y-axis, the y-axis torque is transmitted through the gimbal arrangement to the gyro wheel (Fig.5). This causes a precession about the z-axis, which is resisted by restraining spring (not shown in Fig) between the outer gimbal and frame. For the purpose of providing rate feed back from roll, pitch or yaw to damp out vehicle oscillations about these axes, rate gyros are employed. These have, however, low accuracy.

Integrating Gyros : Referring to Fig.5, if the outer gimbal is fixed to the frame, it will result in an integrating gyro. As the frame (and outer gimbal) rotates about the y-axis, the wheel precession is caused about the x-axis, which means that the inner gimbal rotates about the x-axis. In actual construction, the inner gimbal takes the form of a cylinder filled with inert gas and hermetically seated. The outer case is filled with a viscous fluid of which the density is such that the inner gimbal remains suspended. Thus the load on jewel bearing becomes negligibly small, and the drift is reduced. The integrating gyros are very rugged and extremely accurate.