

## AIR SURVEY PHOTOGRAPHY: EDUCATIONAL INNOVATION

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### Abstract

In 1991, University College London introduced a new course leading to the UCL Certificate in Air Survey Photography. The course has been organised in conjunction with Aerial Imaging Systems Ltd. and PhotoAir and, together, the three participating organisations provide expertise and equipment for practical flying, and photographic and photogrammetric experience for students. The paper sets out the aims and content of the course and gives biographical details of typical students who have been among the first to enjoy this unique educational opportunity.

Key Words: Air Survey, Camera, Education, Navigation, Photography.

### INTRODUCTION

As a vocational subject, mapping and its associated disciplines can only be considered in terms of a wide variety of scholarly pursuits and practical skills. In purely academic terms the subject has, for the main part, been dominated by photogrammetry and cartography. Yet for all of their importance to topographic mapping, the subject starts elsewhere, in the acquisition of the primary data by means of air survey photography.

In educational terms, air survey photography has usually been a poor relation when compared to the rest of the mapping fraternity. Perhaps the root cause for this lies with the subject itself for a mixture of skills and experience has seemingly been sufficient in the past. Experienced aircrew and highly skilled laboratory technicians have always been to hand, often "borrowed" from other fields and disciplines.

In the United Kingdom, the major source of training for aerial photographers has been the Royal Air Force which, since the First World War, has trained thousands of qualified photographers to use and service a variety of air cameras as well as to process air films and to produce mosaics. Although RAF courses established the majority of trained photographers, up to 1960 at least (when the subject became a part of general education), only a few had specific experience in mapping. In the meantime, commercial survey companies provided on-the-job training to mostly former RAF personnel employed as survey flight navigators, camera operators and laboratory technicians, a system not without merit at the time, but soon to become inefficient for an industry that needed to keep up with the latest developments in technology and method.

By 1971, the International Institute for Aerospace Survey and Earth Sciences (ITC) had moved from Delft to Enschede, The Netherlands where courses in aerial photography became well established. For the next 20 years, the one year ITC Diploma courses in Air Survey Photography provided a valuable service for the international mapping community. With custom designed laboratories, its own twin engined survey aircraft (Piper Navajo Chieftain) complete with Zeiss RMK or Wild RC10 cameras and supported with various survey simulators, the course expanded and became ever more efficient, to the point of being vastly uneconomic! As with many an enterprise, as soon as things become ideal, they also become too expensive. Finally the ITC course ended in 1990.

#### THE UNIVERSITY COLLEGE LONDON CERTIFICATE IN AIR SURVEY PHOTOGRAPHY (CASP)

In order to retain the initiative established by ITC, a similar but shorter four month course in air survey photography was established by the Department of Photogrammetry and Surveying at University College London, in co-operation with two commercial survey companies, Aerial Imaging Systems Ltd., which specialises in consultancy and training, and PhotoAir, which provides the aircraft and laboratory facilities. The first CASP course was conducted from April to August, 1991.

The nature of the CASP course is to offer a foundation study of four months covering the basic principles of air survey navigation and photography, with elements of photogrammetry, cartography, remote sensing and aviation in support. The course is

costed realistically and, as a foundation course, is predominantly theoretical in content, the overall principle being to learn on the ground and practice in the air. To this end, the course is about 65 per cent theoretical. It covers all aspects currently required by students who need a refresher course as well as those who require initial training in the subject.

Since practical training for survey flying is expensive and, in many cases, is best experienced with the survey organisation concerned, the UCL CASP course is designed to provide the most economic and cost effective training possible. It gives a sound theoretical foundation supported by intensive demonstration and adequate supervised practical experience.

A considerable number of trained and experienced air survey personnel, including many ITC alumni, now require further training in a variety of subjects (such as advanced survey navigation methods) and so the CASP course is designed to enable further practical training in a number of specialised areas. These advanced additional courses are provided by Aerial Imaging Systems Ltd. (AIS) and PhotoAir and are extra to the CASP course (Appendix A).

#### DETAILS OF THE CASP CURRICULUM

The four month CASP course is divided into two parts, separated by a week in which students visit air survey and photographic organisations in Belgium.

Part 1 is held at University College London and is mainly theoretical, together with demonstrations and educational visits. Instruction is provided by staff of University College London (UCL) and Aerial Imaging Systems Ltd. (AIS).

##### Part 1 Studies

Week 1 (UCL/AIS). Registration and introduction to the course. Mathematics. Calculator software. Visit to PhotoAir.

Week 2 (AIS). Photography, cameras, air survey cameras. Basic mission calculations. Types of mission, specifications, mapping cameras, small format cameras, photographic theory, image quality, film processing.

Week 3 (UCL). Introduction to photogrammetry. Photographic geometry, scale and cover. Map projections. Demonstrations.

Week 4 (UCL). Vision, depth perception, stereoscopy, parallax. Geometry of image and map. Measurement principles. Practical exercises.

Week 5 (UCL). Principles and methods of stereoplotting. Ground control, aerial triangulation. Practical exercises.

Week 6 (UCL). Aerial triangulation, rectification, orthophotography. Practical exercises.

Week 7 (UCL). Cartography (held at King's College London Study Centre in Sussex). Visit to Ordnance Survey, Southampton. Study break. Coursework submission for Part 1.

Week 8 (AIS). Basic navigation. Projections used in air navigation. Definitions. Instruments, atmosphere, flight planning, calculation. Principles of flight. In-flight recognition of terrain features, meteorology, map reading, scale of flight maps. Aeromedical instruction.

Week 9 (AIS). Mission planning and survey navigation. Tolerances, reference elevations, mountainous terrain. Mission preparation (Peterborough area), overlays, flight lines, block pattern flying. Contract tendering, project management, permit applications, aircraft, equipment and materials. Reporting.

Week 10 (AIS). Basic radio, enroute navigation. Charts and planning. Electronic aids for survey navigation. Doppler, inertial, satellite systems, GPS (demonstrations). Aircraft systems, costing and modifications. Air camera and navigation sight installations.

Week 11 (AIS). Photographic theory for aerial survey. Physical and chemical properties of materials. Sensitometry. Monochrome, colour and infrared materials. Laboratory design. Air film processing, field and laboratory methods, machine processing. Processing control, water and temperature control.

Week 12 (AIS). Selection of air films for specific tasks. Film faults (practical analysis). Image quality, exposure, processing, granularity, haze, image motion, effect of turbulence, FMC systems. MTF, OTF, Fourier and edge gradient analysis, microdensitometer application. Digital imagery, CCD cameras. Theory of colour materials. Printing methods, basic and electronic, print materials. Multispectral photography for remote sensing. Oblique photography. Small format systems.

Week 13. Examinations for Part 1. Visit to Belgium (Eurosense and Agfa Gevaert). Students follow a detailed programme of instruction with visits to a number of laboratories. The visit is completed with practical survey flying in a Eurosense aircraft fitted with a Leica (Wild) RC20 air survey camera with FMC. The Agfa Gevaert air films are processed by each student.

## Part 2 Studies

Part 2 of the CASP course lasts for one month, is held at PhotoAir in Yaxley, near Peterborough, Cambridgeshire and is entirely practical. Instruction is provided by AIS staff with the considerable assistance of staff and facilities of PhotoAir.

PhotoAir provide two aircraft equipped for survey:

- (i) Cessna 337 twin engine aircraft fitted with a large format (mapping) camera, navigation sight, RNAV and survey GPS (CCNS 4); and
- (ii) Cessna 172 fitted with a calibrated 70 mm survey camera, video and optical navigation sight, RNAV and survey GPS (CPNS).

During Part 2 of the course, students put into practice the lessons and exercises conducted in Part 1. Each student will log at least 10 hours of flying, during which time the student will be responsible for the flight planning, navigation and camera operation of a variety of missions. Students will process their own air films, both 70 mm and 230 mm, using various processing methods. In addition, the manufacturers will demonstrate the Zeiss (Oberkochen) RMK TOP and Zeiss (Jena) LMK 2000 camera systems. During these periods, all students will have an opportunity to use these cameras (with and without FMC) either on the simulator or in flight, according to flying conditions at the time. Film processing, printing, diapositive and loose mosaic production is conducted at PhotoAir and is supported by a visit to the laboratories of the Cambridge University Committee for Aerial Photography.

Special consideration is given to GPS survey navigation during Part 2 of the course. This allows students to compare their navigation skills when using a conventional navigation sight with their results from GPS navigation, determined from a photographic index from their missions. All students are given an opportunity to plan, compute, fly and analyse a mission employing one or both of the AIS survey systems (CCNS 4 or CPNS).

## SUMMARY

By the end of the CASP course, each student should be sufficiently prepared to engage in aerial survey at a basic level. No claims are made to suggest that, at the end of four months, the CASP student will be an experienced operator (Appendix B) but at least the student will know enough to be aware of the

problems and to know where to seek a solution. The rest is a question of aptitude, skill and, most of all, experience.

Every student will take away a copy of the standard course text, *Manual of aerial photography* by R.W.Graham and R.E.Read, as well as numerous booklets, handout notes, prints and the Psion Organiser complete with AIS survey software.

On successful completion of Part 2 (coursework submission), students qualify for

- (i) University College London Certificate in Air Survey Photography;
- (ii) Licentiatehip of the British Institute of Professional Photography (LBIPP), subject to membership; and
- (iii) in association with (ii), and subject to application and membership, Licentiatehip of the Royal Photographic Society of Great Britain (LRPS).

#### APPENDIX A

##### AIS Advanced Additional Courses in Aerial Survey and Remote Sensing

- (1) Advanced survey navigation (6 weeks).
- (2) System controlled survey flight operations (9 weeks).
- (3) Laboratory processing and management (10 weeks).
- (4) Remote sensing and imagery acquisition (5 weeks).
- (5) Small format mapping (6 months).

#### APPENDIX B

##### Student biographies

W.H.M. (Malaysia) was employed by the Lands and Surveys Department in Kota Kinabalu as an Assistant District Surveyor. He had no previous experience of air survey. His attendance on the CASP course was financed by his employer. On his return, he was responsible for future work in air survey as photographer/navigator with a Cessna 180 and Leica (Wild) RC10 camera.

A.K.M. (Iran) came from the National Cartographic Centre in Tehran where he was employed as an air survey photographer and navigator with considerable flying experience. Soon after returning from the CASP course, he completed a survey in southern Iran. He has a Fokker F27 equipped with Leica (Wild) RC10 and RC20 cameras and GPS for his work. United Nations finance supported his

attendance on the CASP course.

R.C. (Hong Kong) had received his undergraduate education in the United Kingdom (B.Sc., A.R.I.C.S.) at North East London Polytechnic.

The Hong Kong Department of Land and Buildings financed his attendance on the CASP course on which he was awarded a distinction. In Hong Kong, his facilities include three helicopters, a Leica (Wild) RC10 camera and a Hasselblad 70 mm camera. He had completed 50 hours of successful survey flying within two months of his return from the CASP course.

W.A.S. (Saudi Arabia) was sent on the CASP course by a commercial survey company based in Riyadh. Prior to the course, he had limited experience in a Turbo Commander with a Leica (Wild) RC10. He is now working for his employer as a survey navigator/camera operator, using RC10 and Zeiss (Oberkochen) RMK TOP cameras.

K.D. (United Arab Emirates) is a military survey officer with previous relevant education at ITC. He followed AIS advanced courses in air survey laboratory management, GPS survey navigation and remote sensing and, on his return to Abu Dhabi, was responsible for the expansion of the air survey photographic department.

#### APPENDIX C

##### Useful addresses

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