MICROCOMPUTER AIDED DESIGN SYSTEM FOR AERIAL REMOTE SENSING FLIGHT PATH

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ABSTRACT

This paper describes microcomputer aided design system for Aerial Remote Sensing flight path of three sensors, the KS-146 long focal, large oblique camera, RC-20 vertical camera and airborne synthetic aperture side looking radar.
This system consists of GKS graphic processing system, predication system of flight state, data acquisition system of navigation and auto-draft system of flight-pathmap. It can realtime provides geographic coordinates and groud rectangular coordinates of enroute points, magnetic track angles, along track distances as well as corresponding flying time and oil consumption, that to Insure precise and safe-flying. According to user's needs, this system can quickly computes imagery data of three sensors, that to determine position of flight path and complete aerophotographic task. By the end, this system can realtime implements option and majorization for program of aerial remote sensing, tables output of flight data, navigation data and imagery data, and also displays, photographs and autodrafts output of flight path map.

Keycords:
Remote Sensing, system design, navigation

INTRODUCTION

Our company owns a five Lear 35/36. Key fea-fures of these aircraft include: cruise speed 830km/hr, maxium range 5600km(for 36A) and 4500km(for 35A), operating altitude 12300m and fuel capacity of 6000 pound. They are seperately equimpted with visible light camera and airborne synthetic aperture side-looking radar. According to photographic area and scope, designing aerial remote sensing route must consider the major performance of aerial-flyer and utilize characteristic data coming from sensors, meanwhile other factors, for example status of aircraft's takeoff and landing airport, postition of in-flight-replacing magzine, etc, should be concerned with too. Results provided by system include: data of flight and navigation and imaging and qulitity of carried film as well as route chart.
In this case, aided-design system of aerial remote sensing route should be composed of GKS graphic processing system, flight data prediction system, navigation data acquisition system, imaging data caculation system and route auto-drawing system. The briefing of these system is as follows:

1. GKS graphic processing system.
The system is the basic graphic system aided for applied program. GKS graphic data bank, the kerneled system of a two-dimensional graphics, is designed in accordance with ISO 7942---the principle regulated by 1985 international graphic standard, and fully adopt 8086/8088 assembly language editor which directely operate HD63484 graphic-controlled chips. So it is fast. GKS graphic data bank includes fifteen funcations, such as initialization, mapping, open-window editing, map-marking, display operation. graphic correction etc. The system uses three-level constructure, i.e. base interface, funcational description and customer interface. The GKS system can provide aerial remote sensing route design with various pictures (for example: airport planimetric map and route chart) and implements option and majorization of routes with realtime correction.

2. Flight data prediction system.
The purpose of the system is to give a prediction to flight result casued by initially determined flight route, in order to check whether it excceds Learjet regulated specifications. Each flight range and total range which is caculated by input of track-points' coordinates into digitising instrument, and flight time and fuel consumption which is caculated by aircraft speed of liftoff, climb, level off, grid flight, descent and touchdown, guarantee a safe return of aircraft.

3. Navigation data acquisition system.

The system is used to caculate declination angle and longitude and latitude of each point by input of track-points' XS and YS into digitising instrument. Normally, the map designing route is 1:500000. For convenient operation, map's direction and position can be finish on digitising instrument through software at will. The longitude and latitude of each point's geographic coordinates can be caculated by precise formulas of map projection theory. It's easy to operate. First input the longitude and latitude of map corner points, then use cross center of mouse to focus upon these corner points(i.e. survey corner points). Computer shall finish map locating after simplely key in "1" key, and meanwhile, the longitude and latitude way points can be obtained after cross center is focused on way point and "1" key is keyyed in. This way is much faster than manually measuring longitude and latitude by interpolating using ruler, and satisfactorily meet the need of navigation's precision. After test of 117 points on map of 1:500000. + 0. 52 second of its standard error indicates that location error for the most of points is slight. Location time of all 117 points only need twenty seconds (including map location, survey and output time of listing and printing) and increases efficiency five times upward.

4. Imaging data caculation system.

The system suits three sorts of sensors we have. It is easy for RC-20 camera. In accordance with the requirement of customer determined aerial-photographic scope and phogographic scale and overlap rate, the flying altitude above ground the spacing of adjacent distance between routes, the number of route and quantity of required film can be caculated by input of camera lens' alternative focus. Then be listed and printed . But it is more complicated for long-focal, large oblique camera. Camera oblique angle is ranged from 65°-85° Each photography station takes N numbers of picture instead of taking only one. So lateral overlap rate between pictures is not fixed. More distant staying away from photography station, larger overlap rate. In software design, it is divided into both usual condition and unusual condtion. During usual photography, the work mode N, oblique angle, max ground speed, number of picture, length of film, main points' image scale, and image scales of distant-sight line and near-sight line, can be immediately caculated provided that photographic area, flight altitude, the option of two overlap rate of 12% and 56% are known. During unusual one, there's no specific limit for photographic scope, but principle requirement. So first of all, determine work mode and oblique angle data required for photographic scope an usual photography. For example, in aerial-photography of highlights of tourist sight around beijing, the system may give a best implements option to photographic oblique angle and optimize objective pictures three-dimensionally. Such pictures can be used as tourist lookingdown map.

In addition, the best local time and beijing time for photography when sun altitude angle is the largrst, can be caculated for camera operator. Caculating method is like this: according to the year of photographic date, consult the year's sun declination from sun declination table stored in computer, then inputthe longitude and latitude of photographic area.

But it is particular for airborne synthetic aperture radar. Because determining flight altitude by using work mode with terrain conditions is different from visible light camera's way in which flight altitude is determined. By camera focus and aerial photographic scale. After determining altitude, caculate short range and long range with work mode, then come to determine route position with aerial-photographic scope and short range. Because of fixed ground image scale 1:100000, and yet radar image scale 1:100000, 1:12500 along distance and direction seperately, so differences should be considered while caculating other data, for instance spacing of adjacent routes, number of route as well as length of carried film. All data is printed in certain style.

5. Route auto-drawing system.

Before being submitted to higher level authority for approval, route design drawings must be drawn on map. Therefor auto-drawing software system must has funcation of drawing board directing and is able to resolve interchange between geographic coordinates of small scale map and coordinates of graph plotter. In special photography, it is first that routes turn-in points' longitude and latitude, which is required to input into navigation system, should be exactly shown on map, then put points' number on from one to nine in sequence, and points should be connected with straight or arc lines. Here's an example, there are fifty-eight turn-in points along aerial remote sensing route above sichun-tibet road. All fifty-eight turn-in points' longitude and latitude nd ground coordinates can be found by navigation data software, and map's applicable position shall be determined with software of drawing board directing. Using drawing software can display fifty-eight points on map and draws out routes. With corner points' coordinates of aerial photographic scope, usual aerial survey routes can caculate spacing of adjacent routes and the number of routes, and automatically draw out routes which are paralleling and have same distance. Beside drawing output of route chart, photo output may also be taken on high resolution display, and developed and enlargeg to colour picture which is able to show pilots in card style.

Above all, the application of aerial remote sensing route computer-aided design system obviously raises route design's precision and efficiency, and is popular with customers and is a quite practical system.