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Inteligentni transportni sistemi pri načrtovanju in usklajevanju gibanja in parkiranja letal na ploščadi letališča

Intelligent Transportation Systems in the Planning and Coordination of Aircraft Traffic at the Airport Apron

Stanislav Pavlin - Slavko Roguljić

Ploščadi letališča so površine za sprejem in odpremo letal, parkiranje in vzdrževanje. Po mednarodnih predpisih mora biti število prostorov na ploščadi najmanj enako številu letal, ki so hkrati na letališču. Na letališču Split je prišlo v polovici 90. let do pomembne rasti prometa letal, ker je letališče postalo logistična baza ZN za Bosno in Hercegovino. Ni bilo sredstev niti prostora za razširitev ploščadi zato so spremenili organizacijo in koordinacijo prometa. Uvedeni so alternativni prostori in omejitve. Razvit je računalniški program za načrtovanje in usklajevanje prometa letal na ploščadi, ki je kasneje dograjen v GIS-u (geografski informacijski sistem) s sistemoma Arc View in Arc View Tracking Analyst.

Glavna funkcija sistema je, da po načrtovanem in dejanskem prometu predlaga optimalno stezo gibanja in prostore za parkiranje letal z upoštevanjem varnostnih razdalj med letali, ki so v gibanju in tistih, ki so parkirani.

(Ključne besede: gibanje letal, parkiranje letal, načrtovanje, koordinacija)

Airport aprons are areas for aircraft handling, parking and maintenance. According to international rules the number of positions at the apron has to be at least equal to the number of aircraft staying at any one time at the airport. The air traffic at Split Airport increased rapidly in the mid-90s when it became the UN logistics base for Bosnia and Herzegovina. There were no means nor free space for further expansion of the apron, so the traffic had to be reorganised and re-coordinated. Alternative positions and restrictions were introduced. A computer program for apron aircraft-traffic planning and coordination was developed, and then later upgraded in GIS (Geographic Information System) by the systems Arc View and Arc View Tracking Analyst.

The basic function of the system is to suggest optimal aircraft movements and parking positions based on the planned and actual traffic, meeting aircraft safety spacing both in movement and in standing positions.

(Keywords: aircraft movement, aircraft parking, planning, coordination)

0 UVOD

Ploščad letališča je namenjena za sprejem in odpremo letal, parkiranje in vzdrževanje. S stezami za vožnjo je povezana z vzletno-pristajalno stezo. Na njej so prostori za parkiranje, vozne steze, po katerih se letala gibljejo pri prihodu na prostor in pri odhodu s prostora, varnostne razdalje (med letali na prostorih, med letali na prostorih in med tistimi, ki se gibljejo), površine za gibanje vozil in opreme za sprejem in odpremo letal ter površine za vozila in opremo.

0 INTRODUCTION

An airport apron is intended for aircraft handling, parking and maintenance. It is connected with the runway by taxiways. It consists of aircraft parking positions, taxiways at the apron for aircraft movement to the parking position arriving to and exiting from it, safety spacing (between aircraft on the positions, and between aircraft on the positions and those in movement), vehicle and aircraft handling equipment movement areas, and areas accommodating vehicles and equipment.

Razdalje med letali v gibanju in na prostorih predpisuje Mednarodna organizacija civilnega letalstva [1] in znašajo od 3m do 7,5m, dnevno in nočno označevanje (vodilne črte na voznih stezah in prostorih, prometnice za vozila in opremo, reflektorje itn.). Ista organizacija predpisuje, da mora zmogljivost ploščadi omogočiti, da morajo imeti vsa letala, ki priletavajo in odletavajo, na letališču svoj prostor. To pomeni, da letalo ne sme čakati na vozni stezi na prosti prostor na ploščadi. Dovoljeni so alternativni prostori na osnovnih prostorih za letala, ki se na primer redko pojavljajo na letališču.

S prostora na vozno stezo se letalo lahko premakne z močjo motorja letala (samomanevrsko) in s potiskanjem, s posebnim vozilom. Samomanevrski prostori zahtevajo večjo površino ploščadi, medtem ko prostori s potiskanjem zahtevajo draga vozila za potiskanje.

1 LETALIŠČE SPLIT

Letališče Split je odprto za promet od leta 1966. Promet je hitro rastel in je dosegel največje število 1,15 milijonov potnikov in 8 tisoč opravil (pristajanja in vzletanja) v letu 1987. Najpogostejši tip letala je bil DC9 in B727. Površina ploščadi je bila 33 600m^2.

Letališče je zaprla konec leta 1991 Uprava za civilno letalstvo SFRJ. Ponovno ga je odprlo aprila leta 1992 Ministrstvo za promet Republike Hrvaške. ZN so izbrali letališče Split za logistično bazo za Bosno in Hercegovino za humanitarne in vojaške namene. Tipi letal so se spremenili. Prihajajo širokotrupna letala (C5 Galaxy, B747, L1011 itn.) in število operacij v letu 1995 je doseglo skoraj 14 tisoč opravil. Širokotrupna letala so naredila do 3% skupnega prometa.

Povečanje prometa in sprememba tipov letal je pokazala potrebo po:

a) novih prometnih in tehnoloških rešitvah za gibanje in parkiranje letal na ploščadi. Te rešitve določajo alternativne prostore za širokotrupna in tovorna letala,
b) razširitvi ploščadi,
c) načrtovanju vojaškega prometa z ZN,
d) pripravljanju načrta in organizacije prometa kolikor je mogoče učinkovito in prilagodljivo za vsakodnevne potrebe z uvajanjem nove informacijske tehnologije.

Zato je:

a) bila leta 1995 ploščad razširjena na 45.000m^2, tako da je bilo načrtovanih 17 glavnih parkirnih prostorov in 9 alternativnih,
b) bilo novembra leta 1995 prometno načrtovanje na letališču Split dogovorjeno s poveljstvom ZN za

The spacings between aircraft in movement and those parked at the position are stipulated by the International Civil Aviation Organization (ICAO) [1] and they range from 3m up to 7.5m, and vary for day and night markings (guiding lines on taxiways and positions, traffic routes for vehicles and equipment, reflectors, etc.). The same organisation stipulates that the apron capacity has to allow all aircraft being handled at the airport have to have their positions, i.c., an aircraft is not allowed to queue on the taxiway waiting for a free position on the apron. Alternative positions are allowed in addition to the basic ones for aircraft, for instance, that appear less frequently at the airport.

Parking positions are divided according to the method of exiting the position into those from which the aircraft exit by the power of their own engines (self-manoeuvring) and those from which the aircraft exits by being pushed by a special vehicle, i.e., equipment. Self-manoeuvring positions require bigger apron areas than the push-back ones, whereas the push-back areas require expensive vehicles, i.e., push devices.

1 AIRPORT SPLIT

Airport Split was opened in 1966. Traffic rapidly grew and reached a maximum of 1.15 million passengers and almost 8 thousand aircraft operations (landings and takeoffs) in 1987. The majority of the aircraft were type DC9 and B727. The apron covered an area of 33,600 m^2.

The Airport was closed at the end of 1991 by the Yugoslav Air Traffic Services and opened in April 1992 by the Croatian Ministry of Transport. The UN chose Airport Split as its logistics base for Bosnia and Herzegovina for humanitarian and military purposes. The aircraft types and mix changed completely. Widebody aircraft started arriving (C5 Galaxy, B747, L-1011, etc.) and the total number of operations in 1995 reached almost 14 thousand. The number of widebody aircraft amounted to 3% of the total traffic.

The traffic growth and the change in aircraft types showed the need for:

a) new traffic and technological design of the aircraft movements and parking on the apron determining alternative positions for widebody and cargo aircraft,
b) extension of the apron,
c) planning of military traffic with the UN,
d) making the planning and organisation of traffic as efficient as possible and adaptable to everyday needs, through the introduction of new information technology.

Therefore:

a) during 1995 the apron area was extended to 45,000 m^2 so that 17 basic parking positions as well as 9 alternative ones were designed,
b) in November 1995 the traffic planning at the Airport Split was agreed upon with those responsible at

obranitev miru v Zagrebu,
c) bil maja leta 1997 prometni in tehnološki projekt ploščadi končan [2],
d) sistem bil dalje razvijan in prva faza je bila končana konec leta 2000.

2 PROMETNI IN TEHNOLOŠKI PROJEKT GIBANJA IN PARKIRANJA LETAL NA PLOŠČADI

Ploščad letališča Split je povezana z vzletno-pristajalno stezo z dvema voznima stezama: A in B. Širina vozne steze A zadovoljuje vse tipe letal. Vozna steza B ima omejitve za gibanje nekaterih širokotrupnih letal (B747, C5 Galaxy, AN124). Ploščad ima vozno stezo, ki je vozna steza do prostorov in povezuje na ploščadi vozno stezo A in B in omogoča vhod in izhod s prostorov na obe strani vozne steze in vozno stezo za majhna letala (prostori G1, G2 in G3).

Na letališču Split niso imeli vozila za potiskanje letal. Hkrati je bilo veliko število prostorov na eni vozni stezi. To sta bila razloga za izbiro samomanevrskega sistema za parkiranje na ploščadi.

Letala so razdeljeni v 6 skupin, odvisno od izmer. V skupini 1 so majhna letala, v skupini 6 širokotrupno letalo B747 400 in večja letala.

2.1 Glavni prostori

Glavni prostori so označeni z dnevnimi oznakami, neprekinjenimi vodilnimi črtami in prostori za kolesa nosnega podvozja. To so:
1. dva za letala z razponom kril do 34,1m in dolžine do 42m - skupine 3, 2 (prostora 12, 14),
2. osem za letala z razponom kril do 34,1m in dolžine do 37,57m – skupine 3, 2 (prostori 1, 2, 3, 4, 7, 8, 9, 10),
3. tri za letala z razponom kril do 30m in dolžine do 31m – skupina 2 (prostori 5, 6, 11),
4. en za letala z razponom kril do 20m in dolžine do 20m – skupina 1 (prostor 15) in
5. tri za letala z razponom kril do 17m in dolžino do 17m – skupina 1 (prostori G1, G2, G3).

2.2 Alternativni prostori

Alternativni prostori so označeni s prekinjenimi vodilnimi črtami. To so:
1. pet za vojaška tovorna letala C130, razpona kril 34,35m in dolžine 34,35m - skupina 4 (prostori C1, C2, C3, C4, C5),
2. tri za širokotrupna letala z razponom kril 51,66m in dolžino 61,62m - skupina 5 (prostori P1, P2, P3) in
3. en za širokotrupna letala z razponom kril 64,44m in dolžino 70,66m - skupina 5 (prostor P4).

the UN peace-keeping forces command in Zagreb,
c) in May 1997 the Traffic and Technological Design of the apron was completed [2],
d) the system is being further developed, and the end of the year 2000 saw the completion of the first phase of the project.

2 TRAFFIC AND TECHNOLOGICAL DESIGN OF AIRCRAFT MOVEMENTS AND PARKING ON THE APRON

The Airport Split apron is connected with the runway by two taxiways: A and B. Taxiway A meets the requirements of all aircraft types. Taxiway B has a restriction for some of the widebody aircraft (B747, C5 Galaxy, AN124). The apron has the apron taxiway, which at the same time is a taxilane connecting taxiways A and B enabling entrance and exit from positions on both sides of the taxilane as well as a taxilane for general aviation aircraft (parking positions G1, G2 and G3).

The large number of positions by one taxilane and no push-back tractors at Airport Split were the reasons for choosing the self-manoeuvring system of parking at the apron.

Aircraft are divided into 6 groups according to their dimensions. Group 1 represents general aviation and group 6 widebody B747 400 and bigger aircraft.

2.1 Basic positions

Basic positions are presented by daily markings, unbraked guiding lines and positions for nose gear. There are:
1. 2 for aircraft wingspans of up to 34.1m and lengths of up to 42m - groups 3, 2 (at positions 12, 14),
2. 8 for aircraft wingspans of up to 34.1m and lengths of up to 37.57m – groups 3, 2 (at positions 1, 2, 3, 4, 7, 8, 9, 10),
3. 3 for aircraft wingspans of up to 30m and lengths of up to 31m – group 2 (at positions 5, 6, 11),
4. 1 for aircraft wingspans of up to 20m and lengths of up to 20m – group 1 (at position 15),
5. 3 for aircraft wingspans of up to 17m and lengths of up to 17m – group 1 (at positions G1, G2, G3).

2.2 Alternative positions

Alternative position are represented by braked guiding lines. There are:
1. 5 for C130 military cargo aircraft, wingspan of 34.35m and length of 34.35 m - group 4 (at positions C1, C2, C3, C4, C5),
2. 3 for widebody aircraft, wingspan of 51.66m and length of 61.62m - group 5 (at positions P1, P2, P3),
3. 1 for widebody aircraft, wingspan of 64.44m and length of 70.66m - group 5 (at position P4).

Z uporabo alternativnih prostorov P1, P2, P3, P4, in C1, C2, C3, C4, C5, je zmogljivost ploščadi zmanjšana, odvisno od števila in prostorov letal, ki so parkirana na alternativnih prostorih.

Za določanje voznih stez in voznih stez na ploščadi je nujno treba upoštevati določene omejitve pri uporabi alternativnih prostorov.

3 RAČUNALNIŠKI PROGRAM ZA ORGANIZACIJO IN KOORDINACIJO GIBANJA IN PARKIRANJA LETALA NA PLOŠČADI

Omejitve, veljavne za vozne steze, in določene prostore za parkiranje so temelj za razvoj pravil za računalniški program, namenjen kot pomoč za organizacijo prometa letal na ploščadi.

V prvi fazi so projekt računalniškega programa razvijali v glavnem v FoxPro 2.6a in delno v C, za operativni sistem Windows 95, 98 in NT kakor tudi za mrežni sistem Novell 4.11 v modularni strukturi.

Z vzpostavljanjem nadzora števila zasedenih letalnih parkirnih prostorov prikazovalnik pokaže število letal na ploščadi v realnem času, preteklosti in sedanjosti in v načrtovanem času za opravila v prihodnosti. Tako lahko prometni koordinator razmeroma hitro ugotovi, ali je napovedano letalo lahko sprejeto v času, ki ga predlaga zračni prevoznik, ali pa mu predlaga najugodnejši čas pristajanja/vzletanja, s tem da se upošteva tip letala, manevrske karakteristike, gostota prometa in zmogljivost ploščadi.

Slika 1 prikazuje prikazovalnik programa parkiranja na ploščadi: številke 1 do 16 označujejo osnovne prostore za parkiranje, P,C in G označujejo alternativne prostore za parkiranje.

By using alternative positions P1, P2, P3, P4, and C1, C2, C3, C4, C5, the apron capacity is reduced depending on the number and positions of aircraft parked at these alternative positions.

While determining both the taxiways and taxilanes and the parking positions, it is necessary to be aware of certain restrictions resulting from the use of alternative positions.

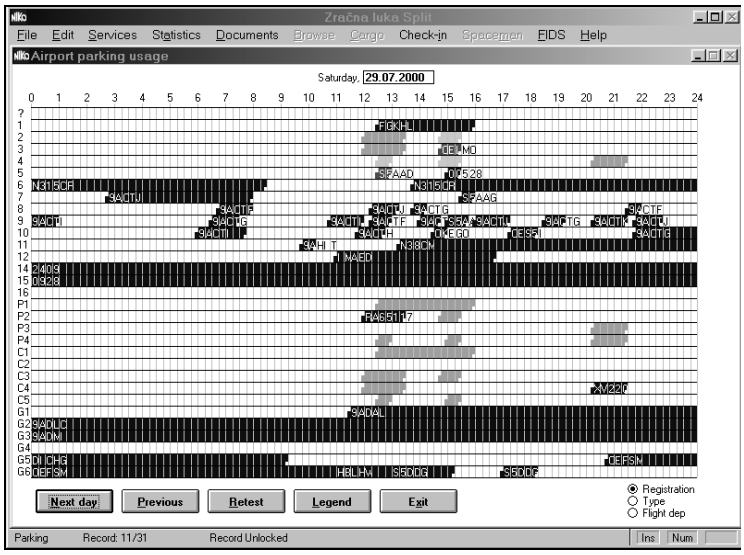
3 COMPUTER PROGRAM FOR THE ORGANISATION AND COORDINATION OF AIRCRAFT MOVEMENTS AND PARKING AT THE APRON

The restrictions valid for taxiways and certain parking positions have served as the basis for developing the rules for the computer program intended to assist aircraft traffic organisation at the apron.

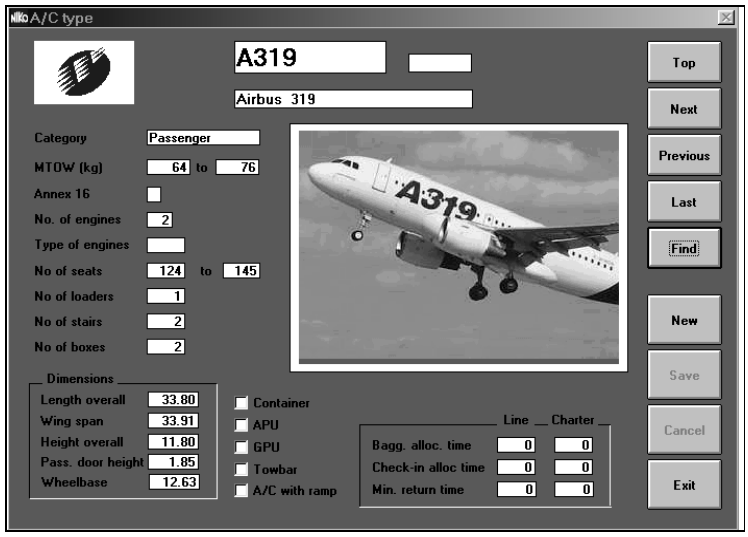
During the first phase of the project a computer program was developed mostly in FoxPro 2.6a and partly in C, for the Windows 95, 98 and NT operating systems, as well as the network system Novell 4.11 in a modular structure.

By switching on the function that controls the number of occupied aircraft parking positions, the display shows the number of aircraft at the apron in real-time, the past and the present, and in planned time for operations in the future. Thus, the traffic coordinator can determine relatively quickly whether an announced incoming aircraft can be accepted within the time suggested by the carrier or the most suitable time of landing/takeoff has to be suggested taking into consideration the aircraft type and manoeuvring characteristics, traffic intensity and apron capacity.

Figure 1 shows the display of the apron parking program: numbers from 1 to 16 mark the basic parking positions and P, C and G mark the alternative parking positions.



Sl. 1. *Uporabniški prikazovalnik programa za koordinacijo gibanja in parkiranja letala*
Fig. 1. *User display of the program for the coordination of aircraft movement and parking*



Sl. 2. *Uporabniški prikazovalnik z osnovno bazo različnih tipov letal*
Fig. 2. *User display with database on various types of aircraft*

Številčna serija od 0 do 24 pomeni ure v enem dnevu. Vsaka celica v časovni seriji pomeni 15 min, tako da eno uro pomenijo štiri celice. Prikazovalnik kaže vsa letala v skladu z registracijo, tipom ali številko leta in ali so bili, so in ali bodo zasedali določen čas tega dne enega od prostorov za parkiranje na letališki ploščadi.

Poudariti bi bilo treba, da računalniški program prikazuje letala natančno na tistih prostorih za parkiranje, ki jih zasedajo. Uporabljajo se barvne oznake:

- prosti prostori (bela),
- prostori, zasedeni z letali enakih ali manjših izmer od tistih za katere so prostori predvideni (temno modro),
- prostori, zasedeni z letali večjih izmer od tistih, za katere so predvideni (temno rjavo),
- sosedni prostori, ki so delno ali popolno blokirani z letalom, večjim od tistega, za katerega je prostor predviden (svetlo rjavo),
- osnovni prostori, ki so popolnoma blokirani z letalom, parkiranim na enem od primernih alternativnih prostorov in nasprotno: alternativni prostori, ki so blokirani z letalom, parkiranim na enem od primernih osnovnih prostorov (svetlo modro).

V časovni seriji celic, označenih z vprašajem, računalniški program prikaže podatke o letalu, za katerega prostor za parkiranje ni določen. Tako prometni koordinator na dolžnosti lahko preveri v katerem koli trenutku število prostih prostorov za parkiranje in lahko odloči o možnostih sprejema novega letala.

3.1 GIS uporabljen za koordinacijo gibanja in parkiranja letala na ploščadi

V sodelovanju z GEOdata iz Splita je model računalnišnega programa na podlagi GIS

The numerical series from 0 to 24 refers to the hours within one day. Each cell within the time series covers 15 minutes, so that one hour encompasses four cells. The display indicates all aircraft according to registration, type or flight number, and that were, are or are planned to occupy at a certain time of a given day, one of the parking positions on the airport apron.

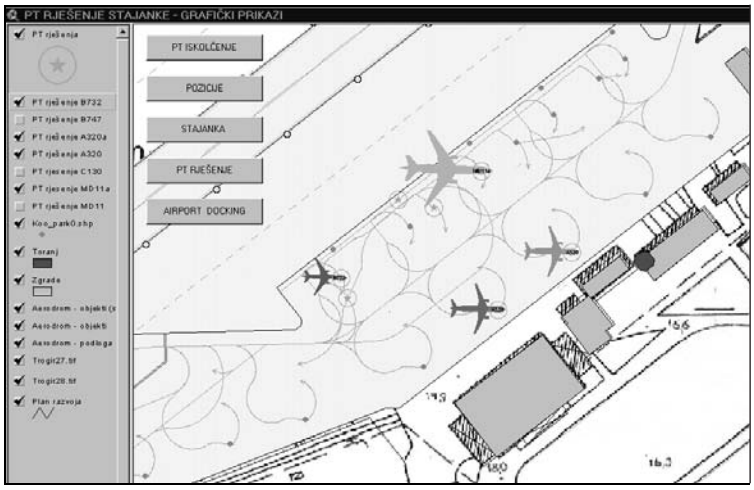
It should be emphasised that the computer program shows aircraft exactly at those parking positions that they are occupying, using colours to mark the suitable time:

- unoccupied positions (white),
- positions occupied by aircraft of the same or smaller dimensions than those for which they have been designed (dark blue),
- positions occupied by aircraft of dimensions greater than those for which they had been designed (dark brown),
- the adjacent positions that are partly or completely blocked due to aircraft bigger than those for which the position it occupies was designed (light brown),
- basic positions that are completely blocked by aircraft parked at one of the appropriate alternative positions, and vice versa: alternative positions that are blocked by an aircraft parked at one of the appropriate basic positions (light blue).

In the time series of cells marked by a question mark, the computer program displays data on the aircraft for which the parking position has not been determined. Thus, the traffic co-ordinator on-duty can check at any time the number of unoccupied parking positions and decide on the possibilities of accepting a new aircraft.

3.1 GIS applied for the coordination of aircraft movements and parking at the apron

In cooperation with GEOdata from Split, a model of a computer program based on GIS was



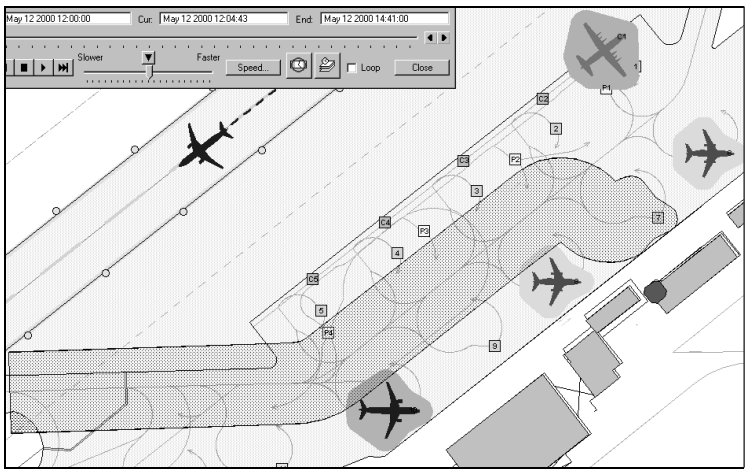
Sl. 3. *Prikazovalnik računalniškega programa za koordinacijo prometa letala v GIS – Arc View*
Fig. 3. *The computer program display for coordination of aircraft traffic developed in GIS - Arc View*

razvit z priključenimi georeferencami in kodiranimi podatki o vseh letaliških objektih, parkirnih prostorih, izmerah in manevrskih karakteristikah različnih tipov letal (sl. 2), varnostnih razmikih med letali itn. (sl. 3). Poglavitna naloga tega programa je, da zagotovi grafično upodobitev gibanja letala po ploščadi v dejanskem času, v preteklosti in prihodnosti, da bi se operater lahko razmeroma hitro odločil glede optimalnega gibanja letala in njegovega parkirnega prostora. Pri tem se morajo upoštevati prostor in izmere že parkiranega letala, izmere in manevrske značilnosti letala, ki parkira, in vozne steze, po kateri letalo prihaja na ploščad.

Uporaba sistema Arc View Tracking Analyst omogoča vidno simulacijo vhoda ali izhoda letala iz danega parkirnega prostora. Preračunan varnostni razmik okoli letala natančno nakaže možne

developed, with installed geo-reference and coded data on all the airport facilities, parking positions, dimensions and manoeuvring characteristics of various types of aircraft (Figure 2), the spacing between two aircraft, etc (Figure 3). The primary aim of this program is to provide graphical visualisation of athe aircraft movements at the apron, both in actual time as well as in the past and future time, for the operator to be able to make, relatively quickly, the correct decision regarding the optimum aircraft movement and its parking position, taking into account the position and dimensions of the already parked aircraft, the dimensions and manoeuvring characteristics of the aircraft that is to be parked, and the taxiway used by the aircraft to enter the apron.

The use of the Arc View Tracking Analyst system enables visual simulation of the aircraft entering or exiting the given parking position. The



Sl. 4. *Računalniški program v GIS – steza gibanja in parkiranja letala A320 z varnostnimi razmiki*
Fig. 4. *Computer program in GIS - path of the A320 aircraft movement and parked aircraft with safety spacing*

točke križanja gibajočega se letala s parkiranimi (sl. 4).

Težave programa, ki je bil razvit v programu FoxPro 2.6a, v prvi projekcijski fazi so bile popravljene z razvojem novega programa, ki ima osnove v programu GIS, ta dovoljuje vsem zaposlenim udeležbo v organizaciji sprejema in odpreme letala, da:

a) lahko preverijo v vsakem času optimalno gibanje in parkirni prostor, ki ga predlaga računalniški program;
b) simulirajo različne verzije gibanja letala po ploščadi, poskušajo dobiti rešitve, ki so različne od predlaganih,
c) oblikujejo varne poti in najboljše parkirne prostore za nove tipe letal na poenostavljen način vhoda primernih tehničnih podatkov.

4 INTEGRACIJA RAČUNALNIŠKEGA SISTEMA

Programi, razviti v FoxPro 2.6a in Arc View Tracking Analyst, so medsebojno združeni tako, da je v vsakem trenutku prostor letala na ploščadi prikazan na prikazovalniku enega programa lahko viden na prikazovalniku drugega programa.

Ti programi so bili nemudoma povezani z računalniškim programom sekundarnega radarja na Kozjaku, da bi lahko natančno določili čas pristajanja. Ti podatki se uporabljajo v sodelovanju s Centrom nadzora zračnega prometa Split, da lahko odločijo, katero vozno stezo bo letalo po pristajanju uporabilo za zapuščanje vzletno-pristajalne steze.

5 SKLEP

Da bi na ploščadi letališča Split lahko obvladali zelo povečani promet, posebej v konicah, v katerih je prevladoval vojaški promet, je bilo potrebno:

- uvesti koordinacijo med ZN in letališčem Split zaradi optimalnega izkoriščanja ploščadi in zmanjšanja zamud,
- uvesti nov sistem parkiranja, ki omogoča na razmeroma majhni površini ploščadi sprejem čim večjega števila letal, od najmanjših do največjih na samomanevrske prostore. Rezultat tega je veliko število alternativnih prostorov in omejitev še posebej pri sprejemu velikih letal,
- uvesti informacijski sistem za načrtovanje, organizacijo in koordinacijo gibanja letal po manevrski površini in na ploščadi, ki bo upošteval vse omejitve in ponudil optimalno uporabo prostorov,
- zaradi preglednosti gibanja letal po ploščadi je sistem dograjen z GIS-om in
- zaradi boljšega ocenjevanja časa pristajanja in gibanja po manevrski površini je sistem povezan z nadzorom zračnega prometa.

calculated safety spacing around the aircraft indicates precisely the possible collision points of the moving aircraft with the parked one (Figure 4).

The drawbacks of the program developed in program FoxPro 2.6a in the first project phase have been corrected by developing a new GIS-based program that allows all the employees participating in the organisation of aircraft handling to:

a) be able to check at any time the optimal movement and parking positions suggested by the computer program,
b) simulate various versions of aircraft movement at the apron, trying to find different solutions from those suggested by the computer program,
c) design safe paths and optimal parking positions for new types of aircraft by means of a simplified input of appropriate technical data.

4 COMPUTER SYSTEM INTEGRATION

Programs developed in FoxPro 2.6a and Arc View Tracking Analyst are mutually integrated in such a way that at any moment the position of an aircraft at an apron presented on the display of one program can be seen on the display of the other program.

These programs are currently being integrated with the computer program of the secondary radar at Kozjak, in order to be able to determine the time of landing of an approaching aircraft with full precision. The data is then used in cooperation with the Air Traffic Control Centre Split to decide which taxiway the aircraft that has landed will use to leave the runway.

5 CONCLUSIONS

In order to be able to accept significantly increased levels of traffic, especially during peak loads with the prevailing military traffic on the Airport Split apron, it was necessary to:

- introduce coordination between the UN and Airport Split for optimum utilisation of the apron and the minimisation of delays,
- introduce a new parking system allowing the handling of the maximum number of aircraft, on a relatively small apron area ranging from the smallest to the biggest on self-manoeuvring positions, which resulted in a solution with a large number of alternative positions and restrictions, especially in the handling of big aircraft,
- introduce an information system for planning, organisation and coordination of aircraft movement across the manoeuvring area and on the apron, which will offer the optimum utilisation of positions taking into consideration all the restrictions,
- upgrade the system with GIS for the sake of the visualisation of aircraft movements,
- connect the system with air-traffic control for improved assessment of the landing time and movement across the manoeuvring area.

Namen razvitih programov je očitno lažje načrtovanje organizacije in usklajevanje gibanja letal na letališču Split. Njihova uporaba je bistveno povečala varnost prometa, vendar opozarja na nujno potrebno gradnjo nove ploščadi.

Programs were developed with the aim of making planning, organisation and coordination of aircraft movements at the Airport Split apron significantly easier. Their application has substantially increased traffic safety, but it has, more than ever, highlighted the urgent need to construct a new apron.

6 LITERATURA
6 REFERENCES

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