

Редакционна колегия:

проф. Александър Александров

Действителен член на БАН

проф. д.б.н. Алберт Кръстанов

проф. д.в.м.н. Байко Байков

доц. д-р Владимир Лазаров

проф. д.м.б.н. Вячеслав Илин

(Русия)

ст.н.с. д-р Денчо Денчев

(Зам. отговорен редактор)

проф. Димитър Караманев

(Канада)

проф. Жан-Пиер Бабари

(Франция)

ст.н.с. д-р Златка Алексиева

ст.н.с. д-р Иван Симеонов

(Отговорен редактор)

проф. Ирини Ангелидаки

(Дания)

проф. Клеменс Постен

(Германия)

доц. д-р Людмил Николов

(Зам. отговорен редактор)

ст.н.с. д-р Нешо Чипев

ст.н.с. д-р Пламен Ангелов

ст.н.с. д-р Тонко Петков

проф. Ячко Иванов

Действителен член на БАН

Техн. редактор: инж. Любен Томов

**Издание на Националното дружество
"Екологично инженерство и опазване на
околната среда"**

Адрес:

ул. "Акад. Г. Бончев", бл. 26

София 1113, Тел.: 979 36 14

Факс: 870 01 09

Editorial board:

Prof. Alexdander Alexandrov

Member of BAS

Prof. Albert Krastanov

Prof. Bayko Baykov

Assoc. Prof. Vladimir Lazarov

Prof. Viacheslav Ilyin

(Russia)

Assoc. Prof. Dencho Denchev

(Deputy editor)

Prof. Dimitre Karamanov

(Canada)

Prof. Jean-Pierre Babary

(France)

Assoc. Prof. Zlatka Aleksieva

Assoc. Prof. Ivan Simeonov

(Editor)

Prof. Iрини Angelidaki

(Danmark)

Prof. Clemens Posten

(Germany)

Assoc. Prof. Ludmil Nicolov

(Deputy editor)

Assoc. Prof. Nesho Chipev

Assoc. Prof. Plamen Angelov

Assoc. Prof. Tonko Petkov

Prof. Yachko Ivanov

Member of BAS

Publishing Editor: Luben Tomov, *Dipl. Eng.*

**Official Publication of the National Society
of Ecological Engineering and Environment
Protection**

Address:

Acad. G. Bonchev St., bl. 26

Sofia 1113, Tel.: (+359 2) 979 36 14

Fax: (+359 2) 870 01 09

E-mail: ecoleng@abv.bg

Http: [//www.geocities.com/ecoleng](http://www.geocities.com/ecoleng)

**Издаването на настоящия брой е с
финансовата подкрепа на:**

"Строй Надзор" ООД

Фонд "Научни изследвания" при МОН

„Алма Пласт“ ЕООД

„Унисист“ ООД

This issue is supported financially by:

Stroj Nadzor Ltd

Ministry of Education and Science –

National Science Fund

Alma Plast Ltd

Unisyst Ltd

CONTENTS

Editor's comment

Ivan Simeonov 3

I. Human and biosphere

Study over the possibilities for using the bees as an indicator for pollution with heavy metal in to environment

Dragomir Manoilov, Nickolay Simeonov 5-10

Use of remote sensing and GIS in mapping urban areas of Egyptian territory for the environmental purposes

Ahmed Ramzi, Nikola Georgiev, Roumen Nedkov 11-16

Preliminary evaluation of noise reduction in Sofia by implementing continuous descent approach procedures for landing at Sofia airport

Vladimir Serbezov, Boryana Bozhkova, Ivan Dimitrov 17-22

Recent achievements in toxic cyanide determination (review)

Andriana Surleva 23-33

Anthropogenic impact on the runoff of the dospat river

Ivan Ivanov, Ljudmila Apostolova 34-40

II. Microorganisms and environment

The genus *Aeromonas* – biology and ecology

Ignat Abrashev, Stephan Engibarov, Roumiana Eneva 41-49

Optimization of nutritive medium composition for extracellular laccase production by *Trichoderma viride*, in submerged fermentation

Velizar Gochev, George Kostov , Albert Krastanov 50-54

Microbiological status of mezophilic anaerobic degradation of cattle manure

Petya Lazarova, Venelin Hubenov, Dencho Denchev 55-60

III. Renewable and alternative energy sources and biofuels

Diagnosis on wind energy

Ouadie Bennouna, Nicolas Héraud, Mohamed Ainan Kahyeh and Ahmed Youssouf 61-65

Biodiesel production from karanja oil by immobilized lipase

David Daniel, Naveenji Arun, Akhil Ramaswamy, Albert Krastanov 66-72

PRELIMINARY EVALUATION OF NOISE REDUCTION IN SOFIA BY IMPLEMENTING CONTINUOUS DESCENT APPROACH PROCEDURES FOR LANDING AT SOFIA AIRPORT

Vladimir Serbezov, Boryana Bozhkova, Ivan Dimitrov

Abstract: This work is a part of a more comprehensive study on the environmental effects of the Continuous Descent Approach (CDA) method of aircraft descent and landing if implemented at Sofia airport. An analysis of the possibility to reduce noise levels in the vicinity of Sofia airport by implementation of the CDA is performed. Also a preliminary quantitative estimate of this noise reduction is calculated. The results show that for the majority of the aircraft types landing in Sofia airport CDA will not affect the noise levels if landing on runway 09 and it will lead only to minor noise reduction if landing on runway 27. These conclusions do not undervalue the other benefits of CDA and they are valid only for airplanes for 100 - 180 passengers, that are most widely used from Sofia airport, but not as general.

Keywords: aircraft noise, noise mitigation, continuous descent approach, CDA

1. INTRODUCTION

One effective way to reduce the environmental impact of civil aviation is by optimizing the aircraft flight trajectory. A part of this optimization is the optimization of the descent and landing of the airplanes, widely known as Continuous Descent Approach (CDA).

The CDA involves the management of the aircraft configuration (flaps, speed brakes, landing gear, and throttles) by the pilot or flight management computer to use the minimum required thrust on a continuous glide angle into an airport. By using the lowest thrust possible and following a standard 3-degree glide angle into the airport, aircraft will produce lower levels of noise than aircraft using higher thrust settings and a "step down" approach. Figure 1 is a depiction of the 3-degree and step down (standard) approaches.

For many airports, the opportunity to implement a CDA is limited because of the volume of air traffic on approach and in the vicinity of the airport especially during daytime periods. When approaching traffic is heavy, a pilot may need to adjust throttles, flap settings, and extend landing gear to maintain safe and consistent spacing with other aircraft in the airport environs. Extending flaps, and landing gear makes an aircraft "dirty" (i.e., increases drag), which requires the application of additional thrust to keep the aircraft flying at the same speed.

Nevertheless many large airports such as Los Angeles International Airport and London Heathrow Airport have introduced CDA. According to tests by Boeing and the FAA, CDA at a single airport can save millions of pounds of fuel, and reduce atmospheric carbon dioxide emissions by millions of pounds.

These facts inspired a researcher group from department of Air Transport of Technical University - Sofia to take an effort in studying the potential benefits that can be achieved by implementing CDA in the Bulgarian airports. In this particular work we investigated the potential for aircraft noise reduction in the vicinity of Sofia airport.

2. ANALYSIS OF SOFIA AIRPORT LOCATION AND AIRPLANE APPROACH FLIGHT PATHS

The information about Sofia airport is taken from the Aeronautical Information Publication of Republic of Bulgaria (AIP) [6]. Sofia airport is situated in the middle of the Sofia valley, eastern from Sofia city (fig.2). The runway of the airport is oriented east-west (09/27). For landings on RWY 09 (airplane landing to the runway from west direction, heading east) the approach corridor lies over the Sofia city centre. The approach corridor for landings on RWY 27 lies in opposite direction, far from the town of Sofia, but near town of Elin Pelin.

To define the cases in which the implementation of CDA will lead to noise reduction in the area of town of Sofia, the

approach routes to the airport must be analysed. These routes for Sofia airport can be classified in four groups:

1. Straight-in approach to RWY 09 - the airplanes come from west and land directly.

2. Downwind approach to RWY 09 - the airplanes come from east, turn 180° and land.

3. Straight-in approach to RWY 27 - the airplanes come from east and land directly

4. Downwind approach to RWY 27 - the airplanes come from west, turn 180° and land.

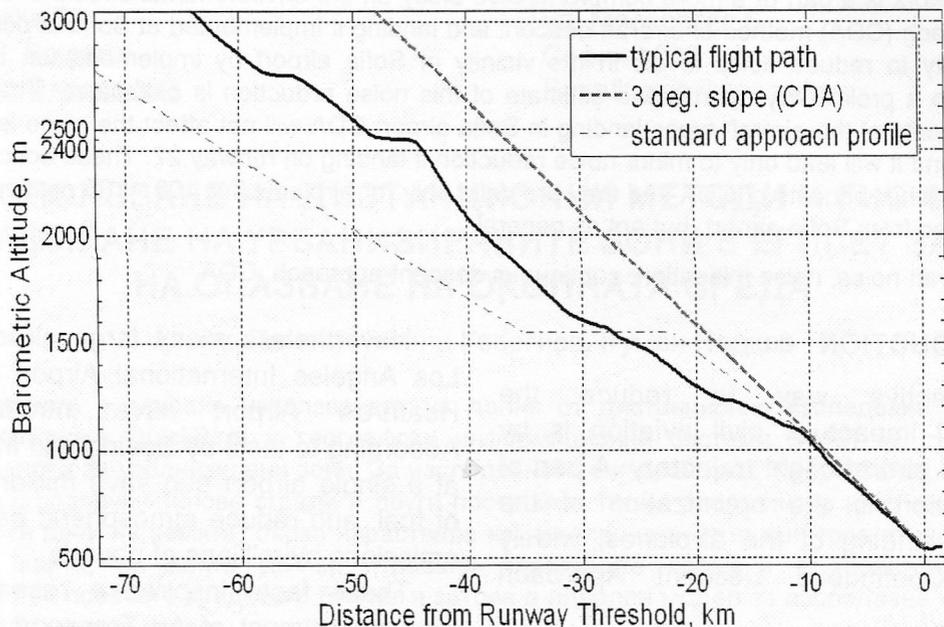


Fig.1. Continuous Descent Approach profile for runway 27 of Sofia airport

For cases 1 and 2 the final part of the approach route lies over Sofia. Because in this final stage the airplane must keep closely the final approach glide slope there is no difference in this stage between CDA and no CDA approach. In these cases the CDA approach will have no noise benefits.

In case 3 the flight route lies far from large populated areas and so it is not of interest also.

In case 4 the standard arrival scheme starts from navigation point NISVA 3C (not displayed on fig.1), passes near Bozhurishte, heading to SOF non-directional beacon, at the west end of the runway. This part of the route lies over the boundaries of the city. After SOF the flight route goes east-north-east, passing near the eastern residential districts of Sofia. Then at a distance of 26 km from SOF the route makes a turn until catching the ILS final approach corridor of RWY 27.

As far as the prevailing wind direction in the Sofia valley is from west and north-west and a significant part of the air traffic is from Central and Western Europe, this is a very commonly used scheme for arrival and landing.

If performing CDA approach on this route the vertical profile of the flight will go at significantly higher altitude over the northern and north-western Sofia districts (fig.2). This will lead to lower noise levels there, compared to non-CDA approaches. It must be noted that the published CDA results show most significant noise reduction for places at distances of 7 to 15 nautical miles (13 - 27.8km) from the runway, along the flight track. This reduction can be up to 4 dB [5]. In our case the mentioned Sofia districts are at much greater distances of approximately 50 to 60 km from runway, along the flight track and much smaller effect can be expected.

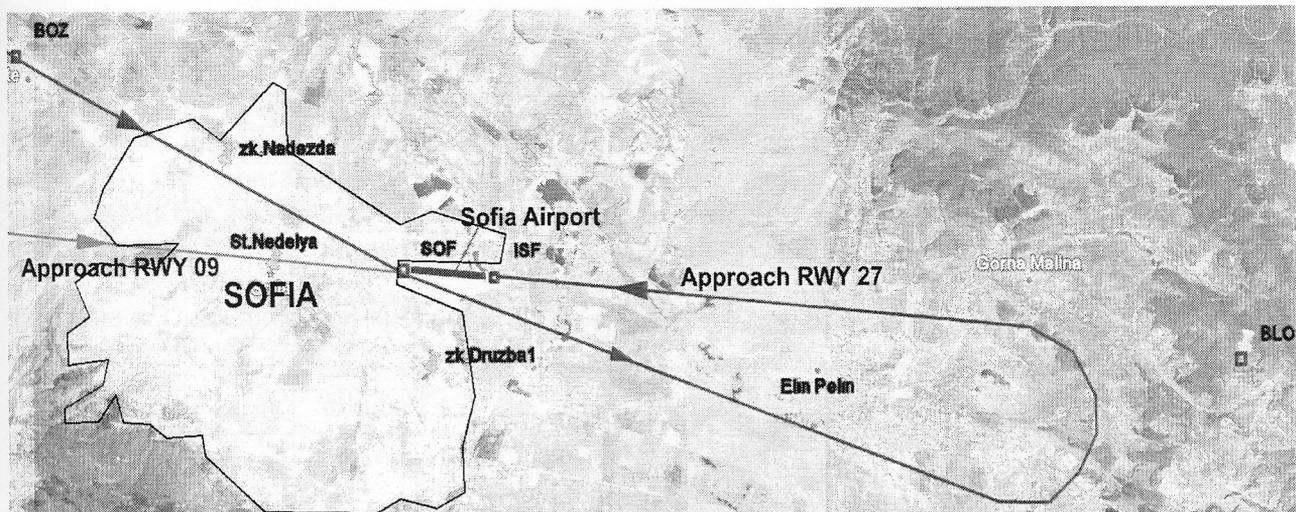


Fig.2. Sofia airport location and runway approach ground tracks

3. CDA AND NON CDA NOISE EMISSION MODELING

To estimate the effect of CDA implementation we modeled the single event noise levels of a typical for Sofia airport aircraft, coming from NISVA 3C and landing on RWY 27, booth with CDA and non-CDA (standard) approach. For the purpose the noise modeling method described in ECAC.CEAC Doc 29 [2,3] was used. The principal source of aircraft noise data is the international Aircraft Noise and Performance (ANP) database which is described in the also in the same document.

It was judged appropriate for the initial evaluation to calculate the noise levels only at tree sites in Sofia. This way the need of complex calculations was overcome. The first site is the St. Nedelia church - representative for the noise levels in Sofia city centre. The second site is the centre of Druzha-1 residential district - representative for the eastern Sofia districts. The third point is in Nadezhda district - representative for the northern parts of Sofia. The geographic coordinates of these tree sites (calculation points) are given in Table 1.

Table 1. Noise calculation points location

Calculation point	Latitude	Longitude
St. Nedelia church	42°41'48.3"N	23°19'17.4"E
zk. Druzha 1	42°39'46"N	23°24'5.4"E
zk Nadezhda	42°43'54.4"N	23°17'51"E

The examination of the aircraft types operating from Sofia airport showed that aircraft with 100 to 160 seats prevail [7]. Most of the air carriers use airplanes of the Airbus A320 and Boeing 737 families. Boeing 737-400 was chosen as a representative airplane to be used in the calculations.

For the purpose of noise modeling the ground track of the flight trajectory is divided in 7 segments. The coordinates of the end points of these segments are given in Table 2 and the segmented ground track, together with de noise calculation points are illustrated in Fig. 3.

Table 2. Ground track segments definition

	Latitude	Longitude
A ₁	42° 50' 30" N	23° 04' 36" E
A ₂	42° 41' 53.2" N	23° 23' 21.8" E
B ₂	42° 35' 45" N	23° 39' 52" E
P ₁	42° 37' 01" N	23° 43' 32" E
P ₂	42° 38' 57" N	23° 44' 10" E
C	42° 40' 07" N	23° 42' 15" E
D	42° 40' 55" N	23° 26' 25" E

The vertical profile of the CDA is calculated as a 3 degrees slope. The height of the reference points of the vertical profile of the non-CDA approach are taken from the AIP [6]. Both flight profiles are shown in Fig. 4.

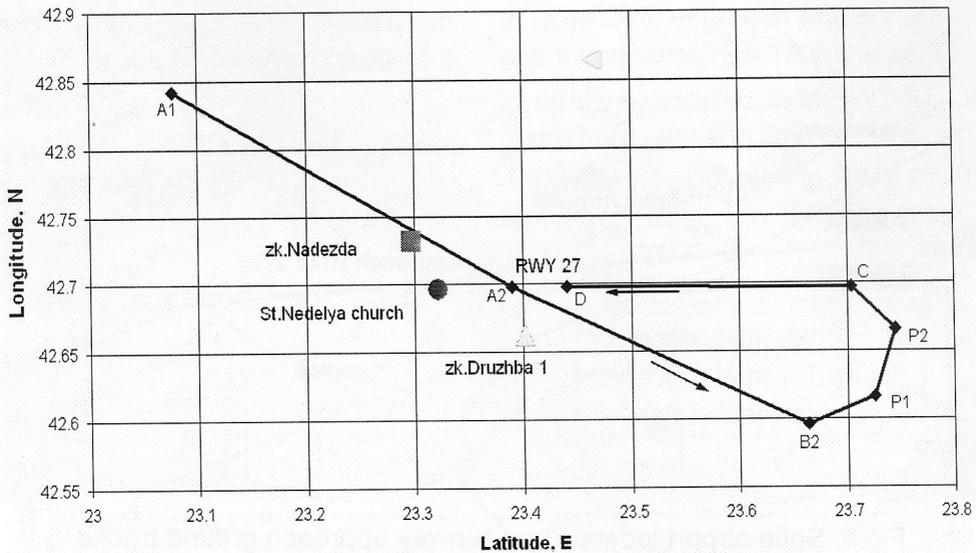


Fig.3. Noise calculation points location and approach ground track to Runway 27

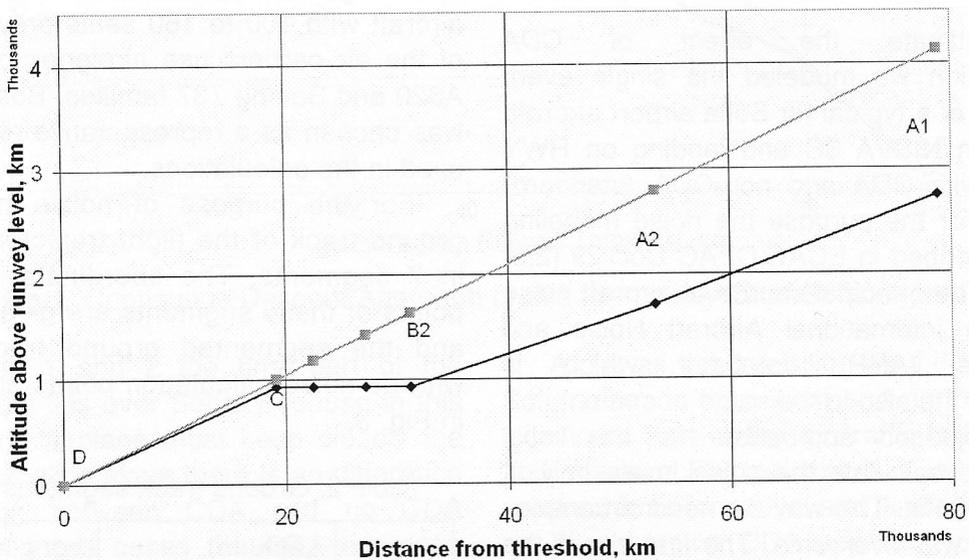


Fig.4. Calculated flight profiles for standard and CDA approaches

Using this data the Effective Perceived Noise Levels (EPNL) (table 3) and Sound Exposure Levels (SEL) (table 4) were calculated. Both noise levels were calculated for CDA and standard approach for every of the tree points. The calculated values for all tree calculation points in the non-CDA case are fare below the 65 dB SEL norm. The CDA shows an average 2 dB decrease in the noise levels. These results corresponds well with the data given in reference [5] and show that this approach for simplified noise modeling can be successfully applied for preliminary noise estimates.

Table 3: Calculated effective perceived noise level

EPNdB	Standard approach	CDA
St.Nedelya	64.1	61.9
zk.Druzha 1	61.6	60.0
zk.Nadezhda	69.9	67.4

The conclusion that can be made from the noise modeling is that the CDA implementation at Sofia airport will not lead to significant noise reduction for Sofia town. It must be noted that an aircraft flying a non-CDA approach can produce much higher noise if performing

horizontal flight path segments near the noise measurement sites even at higher altitude, because of the greater thrust applied. Higher noise levels can be expected also if larger airplanes are operated from Sofia airport. Considering this two cases we can expect that the effect from CDA will be somewhat greater.

Table 4: Calculated sound exposure level

L_E , dBA	Standard approach	CDA
St.Nedelya	45.97	41.50
zk.Druzha 1	57.09	55.57
zk.Nadezhda	50.96	48.1

4. CONCLUSIONS

In order to determine the possible effect on aircraft noise from applying CDA landing procedures at Sofia airport an analysis of the airport location and the approach routes to the airport was performed. The analysis showed that most promising for noise reduction in the populated sites in Sofia valley is the downwind approach route (from west) to RWY 27 which passes over northern and alongside of eastern Sofia districts and then over the town of Elin Pelin.

A limited noise modeling for tree representative points in the central, eastern and northern parts of Sofia for the flight route mentioned above was performed. The calculations were made for Boeing 737-400 as an representative aircraft in the 120-170 passenger seats class. The calculated results show that the single event noise levels are not critical and will not be affected significantly by the CDA implementation.

Assist. Prof. Vladimir Serbezov, MSc.

Department of Air Transport
 Technical University of Sofia,
 8, Kliment Ohridski St.
 Sofia-1000, BULGARIA
 e-mail: vlados@aero.tu-sofia.bg
 phone: +359 2 965 30 78; +359 2 965 25 22

Additional research for sites in the east part of Sofia valley and for other classes of aircraft should be made for better determination of the potential of the CDA. Although the noise reduction from CDA predicted in this work for town of Sofia is negligible it does not undervalue the other benefits from CDA implementation. The authors will continue their research in this direction.

REFERENCES

1. Eric Dinges, Determining The Environmental Benefits Of Implementing Continuous Descent Approach Procedures, 7th Usa /Europe Air Traffic Management R&D Seminar Barcelona, 2007.
2. ECAC.CEAC DOC29 Report on Standard Method of Computing Noise Contours around Civil Airports 3rd Edition, Volume1: Applications Guide, 2005.
3. ECAC.CEAC DOC29 Report on Standard Method of Computing Noise Contours around Civil Airports 3rd Edition, Volume2: Technical Guide, 2005.
4. Dimitrov I., Geshev D., Serbezov V., Research Methodology About Possibilities For Ecological Trajectory Flight During Landing Approach On Sofia-Airport, "Machines, Technologies, Materials", Issue 8-9 / 2008, ISSN 1313-0226.
5. Mather Airport Continuous Descent Approach, Noise Analysis Report, ESA/205117, November 2006.
6. Aeronautical Information Publication, Civil Aviation Administration, Republic of Bulgaria, 2007.
7. <http://www.sofia-airport.bg/>

Assist. Prof. Ivan Dimitrov, PhD

Department of Air Transport
 Technical University of Sofia,
 8, Kliment Ohridski St.
 Sofia-1000, BULGARIA
 e-mail: idimitrov@aero.tu-sofia.bg
 phone: +359 2 965 30 78; +359 2 965 25 22

ПРЕДВАРИТЕЛНО ИЗСЛЕДВАНЕ НА ВЪЗМОЖНОСТИТЕ ЗА НАМАЛЯВАНЕ НА АВИАЦИОННИЯ ШУМ В РАЙОНА НА ГРАД СОФИЯ ПРИ ИЗПОЛЗВАНЕ НА СХЕМА С НЕПРЕКЪСНАТО СНИЖЕНИЕ И ЗАХОД ЗА КАЦАНЕ НА ЛЕТИЩЕ СОФИЯ

Владимир Сербезов, Боряна Божкова, Иван Димитров

Резюме. Настоящата работа е част от по-обширно проучване на предимствата и проблемите свързани с използването на летище София на екологично изгодния метод за кацане с постоянно снижение и заход (Constant Descent Approach - CDA). В нея е извършен анализ на случаите, в които CDA би довел до намаляване на авиационния шум за района на град София и е направена първоначална количествена оценка на това намаление. От извършеното изследване може да се направи извод, че използването на CDA няма да води до значимо намаляване на шума в района на град София. При бъдещо прилагане на този метод за снижение и кацане на летище София определящи биха били намаляването на изразходваното гориво и вредни емисии, при осигуряване на необходимите нива на безопасност на полетите.