Detailed Example Using of the Integrated Noise Model

CEE 4674 – Airport Planning and Design

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Blacksburg, Virginia

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Purpose of the Analysis

- Predict noise contours for two distinct aircraft and compare their noise signatures
- Determine departure noise contours for:
 - Boeing MD-80
 - Cessna Citation 500
- Use Ronald Reagan National Airport runway 01 in our case study

Starting a New Case in INM

• Start a new case in the INM menu

10 INM 7.0	New Study
File Window Help New Study Ctrl+N Open Study Ctrl+O Print Setup Ctrl+U Exit 1 1 C:\\EXAMPLES\TEST50	Path c:\program files\inm7.0\examples\test50 Existing Study SimpleDCAStudy Directories C:\ PROGRAM FILES C:\ PROGRAM FILES Directories C:\ PROGRAM FILES Directories C:\ C:\ Directories C:\ C:\ Directories C:\ C:\ C:\ C:\ C:\ C:\ C:\ C:\
	Drives OK Cancel

DCA Airport (source: Google Earth)

- Use a satellite picture to help you guide the process of creating tracks
- The red track simulates a departure track from DCA runway 01



Selecting the Airport for Our Case Study

• View the airports available and select the one to be used in the study

Study Setup [simpleDCAStudy]		
Units English Created 23-Apr-08 22:31 Description		
A simple study of noise generated by two aircraft using DCA runwau 01 Origin of Coordinates Latitude (deg) 0.000000 Longitude (deg) 0.000000 Elevation (ft) 0.0	Stul View Airports Ur Airports De CT A CT CT IGOR I SIKORSKY MEMORIAL BDR CT CT TWEED-NEW HAVEN HVN CT CT WATERBURY-0XFORD DC RONALD REAGAN WASHINGTON DC WASHINGTON DCA DC WASHINGTON DCA	
UK	DE DELAWARE AIRPARK 33N DE DOVER AFB DOV DE NEW CASTLE COUNTY ILG DE SUMMIT EVY FL ALBERT WHITTED SPG FL ARTHUR DUNN AIR PARK X21 FL BARTOW MUNI BOW FI ROB SIKES CFW	

Verify Information about the Airport

• Always check the runway and setup information in INM

ile Edit View Setup Tracks AcftType Civil Operations Run Output Window Help	
Image: Decision Points Image: Decision Points Image: Decision Points Image: Decints Image: Decision Points	Study Setup [simpleDCAStudy] Units English Created 23Apr-08 22:31 Description A simple study of noise generated by two aircraft using DCA runwau 01 Image: Created (Contract a single a study) Origin of Coordinates Latitude (deg) 38.852083 Airport DCA Longitude (deg) -77.037722 View Airports Elevation (R) 15.0 OK



	Empty Case Window	
• Each new case	is presented in the case window pane	
INM 7.0 - [Study C:\PROGRAM FILE File Edit View Setup Tracks AcftType	S\INM7.0\EXAMPLES\TEST50\simpleDCAStudy] Civil Operations Run Output Window Help	
		-
	Case ID (40 characters or less) Created Description Airport Parameters Temperature (F)	
	Pressure (in-Hg) Modify NPD Curves Humidity (%) Headwind (kt)	

Adding a record	l to start a new case in the INM menu
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Commit Record Ctrl+Enter	
Add Record Ctrl+A Delete Records Ctrl+Del	
Cut Records Ctrl+X Copy Records Ctrl+C Paste Records Ctrl+V	Case ID (40 characters or less) Created Description
	Airport Parameters Temperature (F)
	Modify NPD Curves Humidity (%)

Always Commit Records in INM

• Specify the new case

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Cut Records Copy Records Paste Records	Ctrl+X Ctrl+C Ctrl+V			, [Case ID MD 80D	(40 cha eparture	racters or le _Contours	ess)		_	Created 23-Apr-08 22:4	3
		-			De Sim	scription nulates d	eparture co	ntours f	or an MD80			-
					Air	rport Par	ameters Temperatu Pressure (ir	re (F) n-Ha)	57.9			
							🗌 Modify	NPD C	urves			
							Headwind	(kt)	8.0			
		_	_									

New Case Added to the INM Study

• Write a comment so that you know what the case is about

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ases		
D80Departure_Contours	Case ID (40 characters or less) MD80Departure_Contours	Created 23-Apr-08 22:48
	Description Simulates departure contours for an MD80	
	Airport Parameters Temperature (F) 57.9	
	Pressure (in-Hg) 29.92 Modify NPD Curves	
	Headwind (kt) 8.0	

Add a scenario t	ding a Scenar to your analysis	io in INM	
INM 7.0 - [Study C: VPROGRAM FILES/INM7.0/EXA File Edit View Setup Tracks AcftType Civil Operations Image:	MPLES\TEST50\SIMPLEDCASTUDY\simpleDC Run Output Window Help Scenario ID (40 characters or le Comparison scenario Description Study Cases	CAStudy2Aircraft] ess) Created 23:Apr-08 23:26 Scenario Cases MD80Departure (Remove)	

Adding Aircraft to the Case Study

• INM has civilian and military aircraft

101 INM 7.0 - [S	tudy C:\PROGRAM FILES\I	M7.0\EXA	MPLES	SATEST5	i0\simpl	eDCAStudy]
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	Military Airplanes					
	Helicopters					
	Aircraft Group Assignment					
	Noise Metrics					
	Location Points					
	Population Points					
	File Locations					
	NMPlot Parameters					
		_				



Adding Two Aircraft to the Case Study

• Added Cessna 500 and Boeing MD-81 aircraft

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NM Standard Civ	vil Airplanes			Study Civil Airpl	anes	
LEAR 35 M7235C MD11GE MD11PW MD82 MD83 MD9025 MD9028 MU3001 PA28 PA30 PA31	LEAR 36/TFE/31-2 MAULE M-7-235C / 1054(MD-11/CF6-80C2D1F MD-11/PW 4460 MD-82/JT8D-217A MD-83/JT8D-219 MD-90/V2525-D5 MD-90/V2528-D5 MU300-10/JT15D-5 PIPER WARRIOR PA-28- PIPER TWIN COMANCHI PIPER NAVAJO CHIEFT/	0₩ -161 / 0-321 E PA-30 / I(AIN PA-31-3 ▼	Include >	MD81	MD-81/JT8D-217	(+) (+)
		OK	1	Cancel		

INM 7.0 - [Study (:\PROGRAM FILES\INM7.0\EXAMPLES\TEST50\simpleDCAStudy]
Civil Airplane	Data 🔲 🔀
CNA500 MD81	Aircraft CNA500 Description CIT 2/JT15D-4 Weight Large Owner Engine Jet Noise Stage Max Gross Takeoff Weight (lb) 14700 Max Gross Landing Weight (lb) 14000 Max Landing Distance (ft) 3050 Noise JT1501 Number of Engines 2 Automatic Thrust Restoration Jet Static Thrust (lb) 2500

Commit the Records Added

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	Add Record Ctr Delete Records Ctr	l+A l+Del					ব
	Cut Records Ctr Copy Records Ctr Paste Records Ctr	l+X l+C l+V	CNA500				
		Description Weight Engine	Large Jet Max Gross Tal Max Gross Lar Max Landing D Noise J r of Engines 2	 4 ceoff Weigh nding Weigh Distance (ft) TT15D1 TT15D1 	Owner Noise Stage t (lb) 1470 t (lb) 1400 3050	Gen-Aviation Stage3 0 0 st Restoration	
		Statu	i miusi (ib)	2000			

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Defining the Noise Metric of the Case Study

• Any INM study requires at least one noise metric to be defined. In the U.S. we use DNL

File Edit Viev	v Setup	Tracks	AcftType	Civil	Operations	Run	Output	Window	Help
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Define the Tracks Around the Airport
• Select the input graphics from the Tracks pull down menu
INM 7.0 - [Study C:\PROGRAM FILES\INM7.0/EXAMPLES\TEST50\simpleDCAStudy]
File Edit View Setup Tracks AcftType Civil Operations Run Output Window Help
Image: Constraint of the second se
Track Identifiers Track Segments
Input Graphics



Input Graphic Options

• Zoom in, Zoom out, terrain, adding tracks, deleting tracks are some of the options

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Adding a Departure Track (DEP01)

- Start the departure track at the beginning of the runway where the aircraft is supposed to depart
- Arrival tracks start in the airspace into the runway (make sure the arrival ends at the end of the runway – the final segment of the arrival is over the runway)



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Departure Track Added (Note Color Change to Blue)

- Departure tracks are blue
- Arrival tracks show in red



- Dispersion of a track is to realistically simulate stochastic profiles
- Go to Edit pull down menu and "Disperse Track"



Specify the Dispersion Pattern

• The dispersion is accomplished by specifying the number of subtracks and their position from the original track

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	Disperse Track	
	Operation DEP Runway 01 Track DEP01	
	Number of Subtracks	
	Track Half-Width 0 100	
	Set point 3 0 4 0	
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	0K Cancel 7 0 8 0	
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Adding Operations to the Case Study
• Use the Operations pull-down menu
1
43 INM 7.0 - [Study C:\PROGRAM FILES\INM7.0\EXAMPLES\TEST50\SIMPLEDCASTUDY\simpleDCAStudy2Aircraft]
File Edit View Setup Tracks AcftType Civil Operations Run Outedt Window Help
Civil Runups
Airport Operations
View Calculated Flights

Adding a Reco	ord for Airc	raft Operations
Case Select Select one or more MD80Departure F	INM 7.0 - [Study C:\PROGR Edit View Setup Tracks Ad	CAM FILESVINM7.OVEXAMPLESVTEST5OVSIMPLEDCASTU CftType Civil Operations Run Output Window Help
	C Add Record Ctrl+A	Departure]
OK Cancel	Cut Records Ctrl+Del Cut Records Ctrl+X Copy Records Ctrl+C	Aircraft CNA500 - Runway 01 -
		Operation DEP Profile ID STANDARD1 Track ID DEP01 Number of Flights
		Day Evening Night

Adding Number of Operations

• Add daily, evening and night operations for every aircraft and every track

ile Edit View Setup Tracks AcftType Civ D 🗃 🗃 🚭 🗸 与 + − 🕺 🖻	il Operations Run Output Window Help
Civil Flight Operations - [MD80Depart	ure]
DEP-STANDARD1-XXXXXXXX	Aircraft CNA500 Runway 01 Operation DEP Profile ID STANDARD1 Track ID DEP01 Number of Flights Day 10 Evening 0 Night 10

Commit the Records Added

• Do not forget to commit the records added

Edit View Setup Tracks ActtT Commit Record Ctrl+Enter Revert Record Ctrl+R	ype Civil Operations Run Output Window	Help
C Add Record Ctrl+A Delete Records Ctrl+Del	Departure]	
Cut Records Ctrl+X Copy Records Ctrl+C Paste Records Ctrl+V	Runway 01	
	Operation DEP Profile ID STANDARD1 T	
	Number of Flights	
	Evening 0.000000 Night 10.000000	

View Flight Operations

• You should always view the flight operations before running a case study

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Case or Scena	ario MD80Departure		•	
	View Records	View Summary		
Flight Opera	tions Filter			
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Summary of Flight Operations

• This window shows the summary of the flights added to the case study

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File Edit View	Setup 1	Tracks AcftTyp	e C	ivil Operatio	ins Run Outp	ut Window	Help			
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CNA500	D	STANDARD	1	01	DEP01	0 —		3.860000	0.000000	3.860000
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CNA500	D	STANDARD	1	01	DEP01	2 —		2.440000	0.000000	2.440000
CNA500	D	STANDARD	1	01	DEP01	3 —		0.630000	0.000000	0.630000
CNA500	D	STANDARD	1	01	DEP01	4 —		0.630000	0.000000	0.630000

Setup the Airport Grid for Noise Calculations

• Here we tell INM about the specific grid to calculate noise

1 INM 7.0 - [Study C:\PROGRAM FILES\INM7.0\EXAMPLES\TEST5	50\SIMPLEDCASTUDY\simpleDCAStudy2Aircraft]
File Edit View Setup Tracks AcftType Civil Operations Run Output	Window Help
□ ☞ ■ ● ✓ □ + - ※ 階 億 № Grid Setup	
Run Start	
Let a let	INM 7.0 - [Study C:\PROGRAM FILES\INM7.0\EXAMPLES\TEST50\SIMPLEDCASTUD
	File Edit View Setup Tracks AcftType Civil Operations Run Output Window Help
1	
	Select one or more
	Comparison scenario
	OK Cancel

Grid Setup

- You need to add a grid point setup
- Usually, defaults work well
- Sometimes if the noise contours go outside of the default grid, increase the grid size changing the distance between points

Edit View Setup	Tracks AcftType Civil Operations Run Output Window Help
Grid Points Setup	- [Comparison scenario]
	Grid Type Contour
	Grid I d
	Coordinates O X/Y O Lat/Long
	Grid Origin
	[nmi] [nmi] Distance Retween Points
	- Number of Points
	Grid Botation Angle (deg)
	Time Above or Delta Dose Metric
	C Fixed Threshold (dB)
	C Relative Threshold Ambient + Delta (dB)
	Do Percent of Time (hr)

File Edit View Setup E E E Image: Comparison of the setup	Adding a Grid Setup C: VPROGRAM FILES VINM7. OVEXAMPLES VTEST 50 VSIMPLED CASTUDY Vsimp Tracks AcftType Civil Operations Run Output Window Help D + - & B & K?	and the second s
CONTOUR	Grid Type Grid Type Contour Grid Id CONTOUR Coordinates X (nmi) 8.0000 Y (nmi) 8.0000 Distance Between Points I (nmi) 16.0000 J (nmi) 1 2 J Caid Rotation Angle (deg) 0.0 Time Above or Delta Dose Metric Fixed Threshold (dB) 85.0 Relative Threshold Do Percent of Time (hr)	

Run Options

Here we specify the metric to use and the noise calculation run parameters (contour, points)

	?	
Run Options	Scenario Comparison scenario Run Type Single-Metric	
	Do Terrain Lateral Attenuation All-Soft-Ground ▼ Use Bank Angle Do Contour Use Boundary File Recursive Grid Fixed Grid Spacing 1000.0 (tt) Number of Grid Points 9604	 □ Do Population Points □ Do Location Points □ Do Standard Grids □ Do Detailed Grids □ Save 100% Flights □ Calculate Metrics □ DNL □ NEF □ CNEL □ WECPNL □ LAEQ □ EPNL □ LAEQ □ EPNL □ LAEQ □ PNLTM □ LAEQN □ TAPNL □ SEL □ CEXP □ LAMAX □ LCMAX □ TALA □ TALC
	Last Run Duration	

Specify What Scenario to Run

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Run Start Scenario List	Scenarios to Run
	Comparison scenario (+) Include > < Remove
	Multithreaded OK Cancel

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Specify the Output

• Go to Output Setup to create a new output scenario for INM to save your results

40 INM 7.0 - [Study C:\PROGRAM FILES\INM7.0\EXAMPLE	SVTEST50\SIMPLEDCASTUDY\simpleDCAStudy2Aircraft]
File Edit View Setup Tracks AcftType Civil Operations Run	Output Window Help
	Output Setup Output Graphics Annualize Scenario
	Contour Points Contour Area and Pop Area Contour Coverage
	Standard Grids Detailed Grids
	Noise at Pop Points Noise at Loc Points
	Scenario Run Input Report Flight Path Report

Creating a New Output Scenario

• Add a new record to create a new output

Output Setup	
	Output ID 40 characters or less)
	Metric CEXP
	Output Type OneScenario 💌
	Scenario Comparison scenario
	Scenario 2 Comparison scenario
	Scenario 3 -NONE-
	SCENARD 4 L NOME

Edit View Setup Tracks AcftType Civil Operations Run Output Window Help
Output Setup Output of Cessena 500 departures Output of Cessena 500 departures Output of Cessena 500 departures Metric DNL Contour Levels Min Dutput Type OneScenario Scenario

Viewing the Output of INM

• Every output scenario created will show in the Output window

File	Edit View Setup Tracks AcftType Civil Operations Run Output Window Help	
D	G ■ ∰ ✓ ⊃ + - X B B K?	
)ut	put Select	
	Select one or more	
0	Dutput of Cessna 500 departures	
	OK Cancel	

Output Graphics (Contour) Once the program runs, the noise contours are generated • 🋂 INM 7.0 - [Study C:\PROGRAM FILES\INM7.0\EXAMPLES\TEST50\SIMPLEDCASTUDY\simpleDCAStudy2Aircraft] File Edit View Setup Tracks AcftType Civil Operations Run Output Window Help √ 5 + - 3 陶 億 N? Output - [Output of Cessna 500 departures] € € € 6 6 6 6 6 7 7 7 8 7 7 8 7 8 7 8 8 7 8 8 8 7 8 8 8 7 8 8 8 8 7 8 8 8 7 8 8 8 7 8 8 8 8 9 8 8 9 8 9 8 9 8 9 8 9 8 9 8 9 9 8 9 <p Cessna 500 (Citation) 10 day departures 10 night departures

Next Steps

- Add other aircraft and other tracks
- Export to Autocad (DXF file)
- Perform sensitivity analysis (adding more scenarios)

Exporting to Other Programs

• INM can export noise contours in DXF and Shape file formats

ฎ INM 7.0 - [Study C:\PROGRAM	ILES\INM7.0\EXAMPLES\TEST50\SIMPLEDCASTUDY\sim
File Edit View Setup Tracks Actilyp	e Civil Operations Run Output Window Help
Save Study Ctrl+S	
Import Data into Study	departures]
Delete Non-essential Files	
Print Setup Ctrl+U Scaled Printing	
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Print Ctrl+P	
Export as DXF	
Export as ShapeFile	55.9
Export as MIF/MID	
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Comparing Noise Contours

- Ran the INM 7 model with individual profiles for MD-81 and the Cessna 500 (Citation)
- The results show the striking difference between two aircraft noise contours (at 55 DLN level)

