Intersection Takeoffs and their Noise Impact around the BER Airport

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Introduction

In 2024, the Berlin Brandenburg Airport Aircraft Noise Commission received calls for a widespread ban on so-called intersection takeoffs (ITO) [1]. Intersection takeoffs are takeoff procedures that do not utilize the entire length of the runway. (Figure 1).

Figure 1: Intersection takeoffs are takeoff procedures that do not utilize the entire length of the runway.[1]

In a master's thesis, the impact of intersection takeoffs on relevant parameters for airlines, the environment, and residents will be investigated. The following parameters will be examined:

- Noise
- Fuel consumption / CO_2 emissions
- Time required

Where possible, a monetary assessment should also be conducted.

The focus of this paper is on the noise impacts, initially evaluating only the measurements from the aircraft noise monitoring system.

Scope of the investigation

A total of 40,724 flight movements were included in the study:

- Period: 1st May to 31st October 2024
- Flight movements: Scheduled traffic
- AzB class: S 5.2 (Airbus 320, Boeing 737, etc.) with a total share of 77% of all flight movements at BER
- Noise analysis based on two airlines operating at the airport: Ryanair and easyJet Europe
- Calculation of the average maximum level (at least 50 measured values per measuring point).

Figure 2 shows the layout of the airport and the usable taxiways.

[1]https://www.aviationfile.com/wp-content/uploads/2020/09/Intersection-takeoff-1024x635.jpg

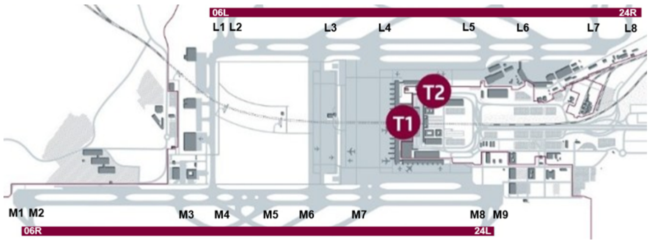

Figure 2: Layout of BER airport with taxiway designators.

To distinguish only two cases (full runway length and intersection takeoff), some taxiways were combined. The assignment is shown in table 1.

Table 1: Roll-up points - full track length and ITO - for the individual tracks and operating directions.

Operating direction	Runway	Full Length	ITO
East	North	L1;L2	L3;L4
West	North	L7;L8	L5;L6
East	South	M1;M2	M3;M5
West	South	M8;M9	M4;M6;M7

The number of recorded aircraft movements for the individual takeoff points is recorded in table 2. Except for takeoffs from the south runway heading east, approximately 50% of takeoffs are intersection takeoffs. On the south runway heading east, the proportion of intersection takeoffs is approximately 65%. This is due to the parking positions being located around the terminal and therefore far away from the end of the runway.

Table 2: Number of flight movements on each taxiway.

Northern runway			
Operating direction	Full Length	ITO	Total
East	L1: 309 L2: 3,486	L3: 2,043 L4: 645	6,483
West	L7: 4,255 L8: 205	L5: 1,022 L6: 2,666	8,148
Southern Runway			
Operating direction	Full Length	ITO	Total
East	M1: 286 M2: 3,630	M3: 6,418 L5: 140	10,474
West	M8: 6,365 M9: 842	M6: 15 M7: 8,397	15,619

The analysis focused on the two most frequently operating airlines at BER, which provides a comprehensive insight into the impact of noise. In addition, both airlines carry out ITO and full length takeoffs, which provides a basis for comparison. From the perspective of operations, the airlines differ in terms of the operating area, departure procedures, and aircraft types. The differences are listed below.

Ryanair

- Around 7,300 takeoffs (18% of analyzed movements)
- Operating area north runway
- Departure procedure: NADP1
- Most used aircraft: Boeing 737-800 with CFM56-7B26E Engine

easyJet Europe

- Around 5,900 takeoffs (14% of analyzed movements)
- Operating area south runway
- Departure procedure: NADP2
- Most used aircraft: Airbus 320-214 with CFM56-5B4/3 Engine

Results

At each noise monitor (NM) the average maximum noise levels have been calculated. In the following maps average maximum noise levels are written near the noise monitor location beneath is the difference to intersection takeoffs. Positive values indicate higher levels of intersection takeoffs. Only noise monitors with at least 50 valid maximum noise levels are listed.

In figure 3 results of westbound departures of the northern runway are plotted on a map. For noise monitors located directly beneath the flightpath, maximum noise levels of intersection takeoffs are higher than full length takeoffs with decreasing differences at farther distances from the runway. Highest difference (2.4 dB) is at noise monitor 8.

In figure 4 results of eastbound departures of the northern runway are plotted on a map. Again for noise monitors located directly beneath the flightpath, maximum noise levels of intersection takeoffs are higher than full length takeoffs with decreasing differences at farther distances from the runway. Highest difference (4.4 dB) is at noise monitor 5 which is located just 2 km behind the end of the runway. There is a special result at noise monitor 3 which is located sideways of the full length starting point. Noise level reductions of 11.5 dB have been denoted for intersection takeoffs.

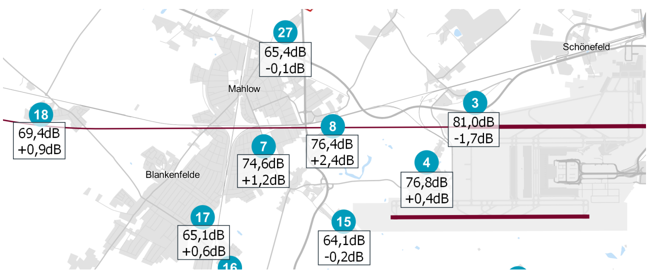

Figure 3: Results westbound departures northern runway. Kartengrundlage: OSM - Lizenz: Creative Commons BY-SA 2.0

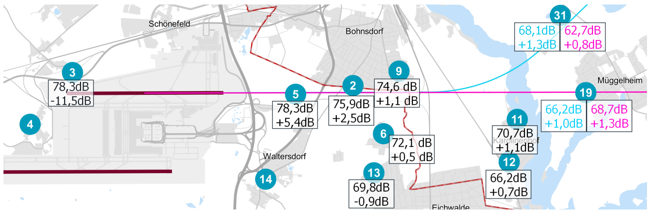

Figure 4: Results eastbound departures northern runway. Different departure routes have been marked in different colors. Kartengrundlage: OSM - Lizenz: Creative Commons BY-SA 2.0

In figure 5 results of westbound departures of the southern runway are shown with similar results. Here is a special result at noise monitor 4 which is located in the middle between the runways. Noise level reductions of 2.7 dB have been measured for intersection takeoffs. The lower levels for intersection takeoffs are explained through the lower height and the sideways located buildings which show a shielding effect.

In figure 6 results of departures of the southern runway on the Q-departure routes (Q-SID) are shown. Against expectations based on the findings before, results show a bigger difference of 7-8 dB in favour of intersection takeoffs for the near located directly crossed noise monitor 21. On the other hand the sideways located noise monitor 14 show up to 6 dB higher values.

To understand these results it is helpful to take a look at the radar plots for both cases (figure 7).

The Q-SID departure procedure in the eastbound direction on the southern runway consists of a right turn, which should be started when the aircraft reaches a level of 600ft above the ground. Airplanes that use the full length of the runway arrive at this level earlier and usually cross noise monitor 21. Intersection takeoffs regularly overshoot the predicted flightpath and pass closer to noise monitor 14 leading to higher sound pressure levels.

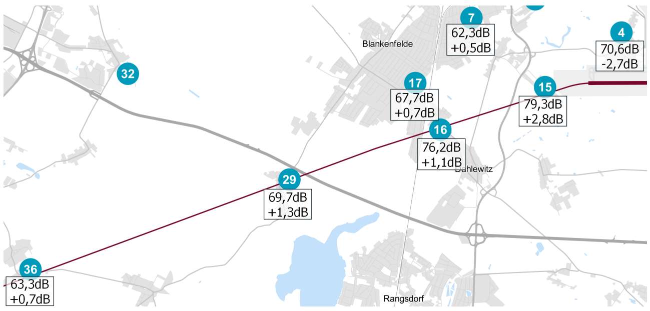

Figure 5: Results westbound departures southern runway. Kartengrundlage: OSM - Lizenz: Creative Commons BY-SA 2.0

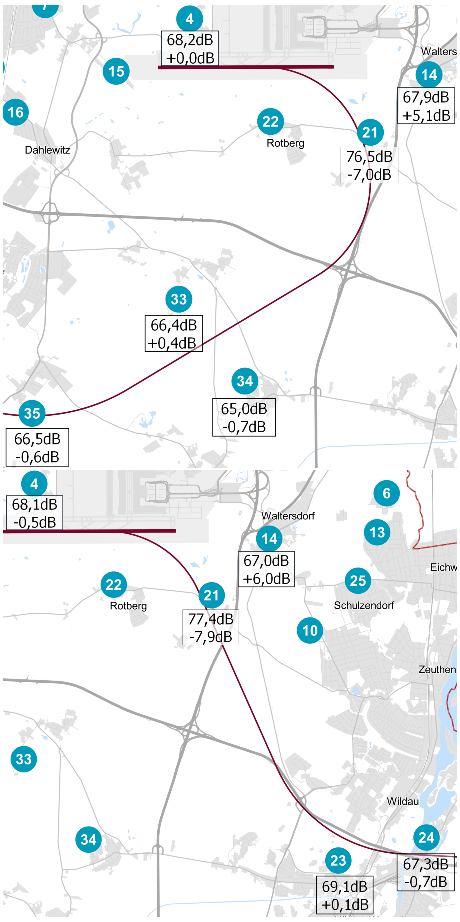

Figure 6: Results eastbound departures southern runway. Above: western destinations, below: eastern destinations.Kartengrundlage: OSM - Lizenz: Creative Commons BY-SA 2.0

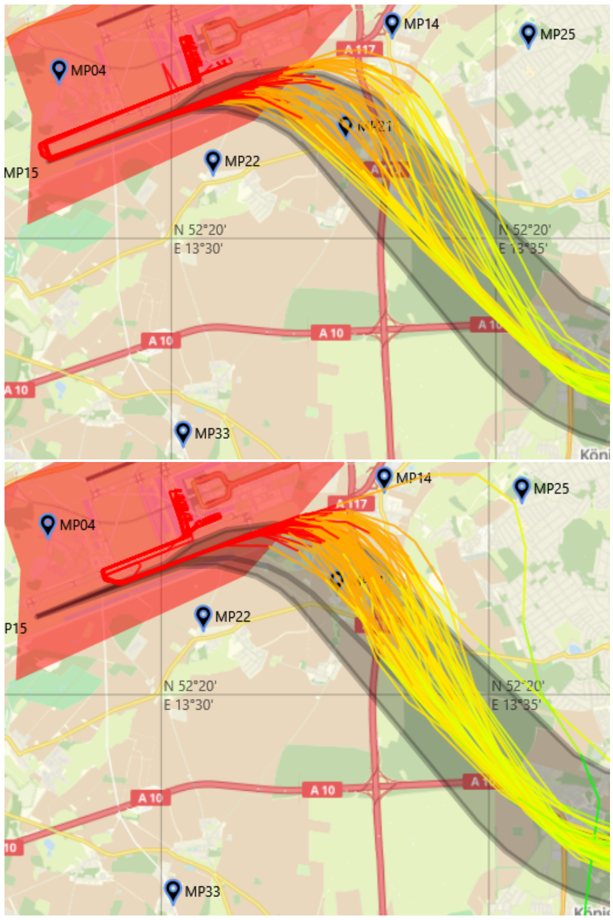

Figure 7: Radarplots of eastbound departures southern runway. above: full length takeoffs. below: intersection takeoffs.Kartengrundlage: OSM - Lizenz: Creative Commons BY-SA 2.0

Conclusion

In this paper, the noise impact caused by takeoffs at intersections was analyzed to determine whether a ban would be justified. The results, based on measurement data, reflect the current status and support the validity of the findings. A variable effect is observed: ITOs lead to higher noise levels near the runway, which gradually decrease with increasing distance. Additionally, ITOs can result in location-specific advantages (NM 21: -7.9 dB, NM 3: -11.5 dB). For takeoffs from the southern runway towards the east, the data show that ITOs result in audible differences (+5.1 dB / +6.0 dB) at noise monitor 14. However, this operating direction must be given particular consideration, regardless of full length takeoffs or ITOs, due to the predominantly high frequency of overshoots. In conclusion, it can be determined that a prohibition is not substantiated, given the predominantly moderate noise disparities.

Prospects

The additional parameters mentioned at the beginning are intended to extend the scope beyond the noise aspects and provide a detailed and comprehensive analysis of intersection takeoffs. In addition to the extant measurement data, the software simulation tool designated 'Aviation Environmental Design Tool (AEDT)' is to be utilized as a further method. This will allow the consideration of any possible point on the map and area calculations including resident numbers. The topic will be rounded off with discussions with various actors, such as pilots and air traffic control (ATC).

References

[1] Gemeinsame Obere Luftfahrtbehörde Berlin-Brandenburg. (2024). Sitzungsprotokoll der 108. Sitzung; URL: `https://lubb.berlin-brandenburg.de/wp-content/uploads/Ergebnisprotokoll-der-108.-Sitzung-der-Fluglaermkommission.pdf`; visited 31.03.2025