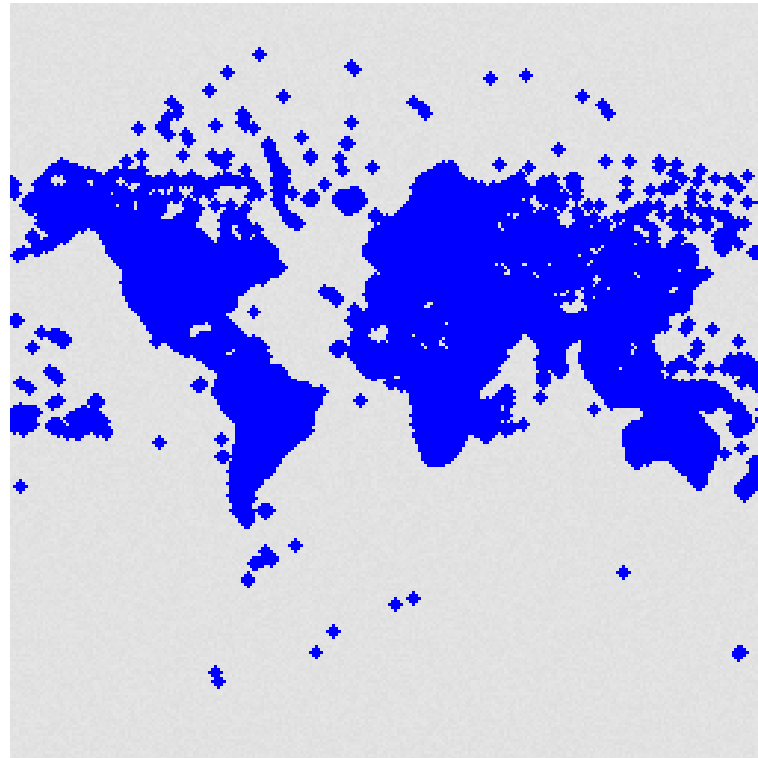


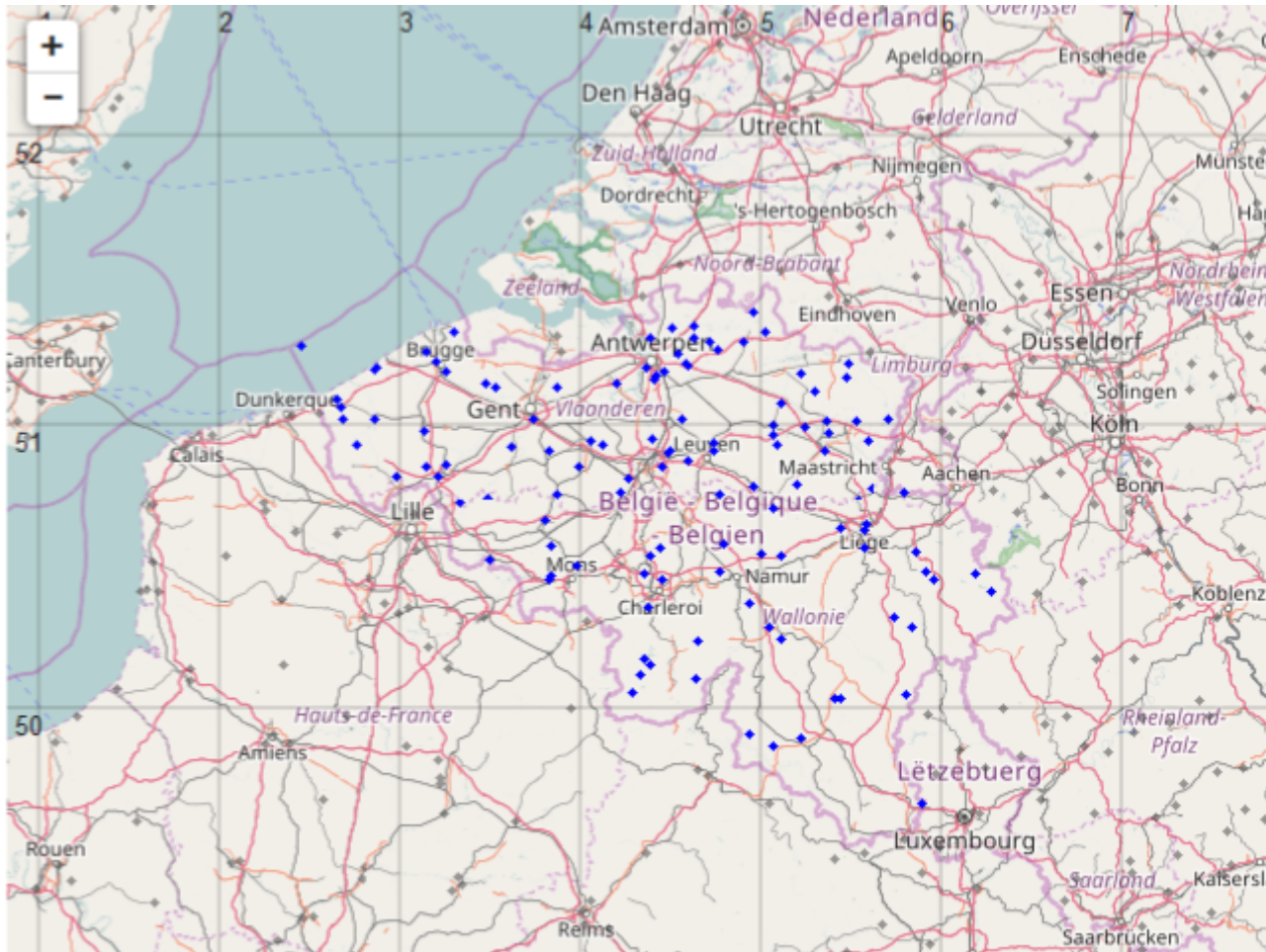
airspace-v.com international hangar flying!



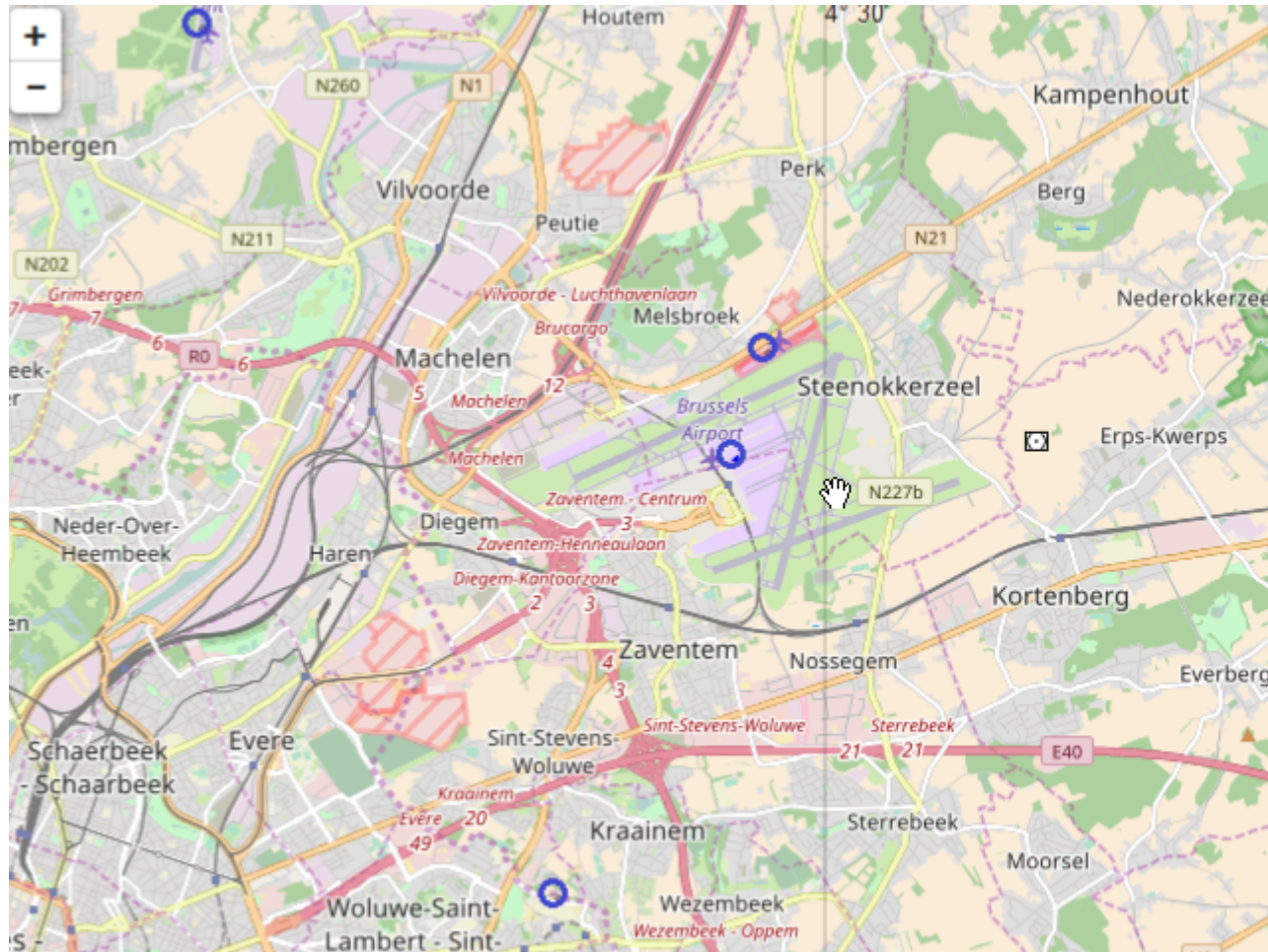
What's up?

- Site information
- POIs around / distances on earth
- KWIC index
- Suffix array

Maps with Airport Tiles



Airports and Nav aids Markers



Map Data

- Maps can be configured interactively
- Predefined e.g.:
 - OSM Mapnik
 - ESRI image
 - HERE hybrid
 - FAA sectionals via vfrmap.com
 - Topo / hillshading
- Mercator projection is precomputed for markers

Tooltip Links to Airport Information

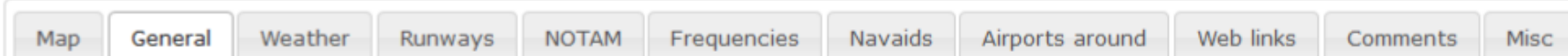
airspace-v.com - international hangar flying!



Brussels Airport • EBBR • BRU

Location:

[Earth](#) • [Europe](#) • [Belgium](#) • [Brussels-Capital Region](#)



General Information

Airport codes: EBBR • BRU

Type: large airport

Scheduled service: yes

Location: 50.90140 N, 4.48444 E / 50° 54.0' N, 4° 29.0' E

Elevation: 184 ft / 56 m AMSL

Sun times: BCT: 06:37, sunrise:07:12, sunset: 16:39, ECT:17:14

Magnetic variation: 1° E

Aviation Data

- Airport and navaid data from ourairports.com
- Magnetic variation is computed by getWMA
- Sunrise, sunset, twilights are computed by PHP
- Weather is taken from official site
- NOTAMs are taken from official site
- Weather and NOTAMs are cached

Future Aviation Data

- Check and complete current data with official data from AIP, AFD
- More data
 - Obstacles
 - Navigation lights
 - Airspace
 - These data are in PDF to be converted and parsed
- Web links (airports, flight schools, flying clubs...)

Software used

- PHP
- SQLite
- MySQL
- jQuery UI
- Leaflet
- StaticMapLite
- getWMA
- Commentics

Airports / Nav aids Around

- Find nearest airports / nav aids
- Compute distances
- We assume spherical earth (error < 2%)
- Haversine formula:

$$d = \text{acos}(\sin(\text{lat1}) * \sin(\text{lat2}) + \cos(\text{lat1}) * \cos(\text{lat2}) * \cos(\text{lon2} - \text{lon1})) * 6371\text{km}$$

Trigonometric Functions

- Haversine requires *sin* and *cos*
- Database might not provide these (e.g. sqlite)
- We can precompute *sin(lat)* and *cos(lat)*
- precomputing *cos(lon2 – lon1)*?
- Quadratic complexity
- Too much, cannot be done

- Really?

Yes, we can!

- Trigonometric identity for angle differences
- $\cos(lon2 - lon1) = \sin(lon2) * \sin(lon1) + \cos(lon2) * \cos(lon1)$
- Apply this identity to haversine formula
- Reduce complexity to linear
- We can precalculate all *sin* and *cos* values and by this also precalculate $\cos(lon2 - lon1)$
- No *sin* / *cos* computation in query
- Wider choice of databses / performance increase

Name Search

- GNIS data from BGA and NGA
- Simple Approach: use database
- Database index designed for read and write
- This gives suboptimal algorithms
- Performance sufficient for small datasets
- There are several 10 Mios items
- Optimizing for read might give higher performance

KWIC – Key Word In Context

- Search all words in all items
- Has been used at times of low computing power
- For instance in libraries
- Binary search allows fast finding of words
- Can be used to find word prefixes
- Autocomplete

Suffix Array

- Suffix array is a data structure
- Introduced in 1990 and still not very popular
- A suffix array is generated from a string
- Can be considered as KWIC extension
- Allows fast finding of substrings
- Autocomplete

Suffix Array Example (1)

- String: bananas
- Each suffix gets index
- 0 bananas
- 1 ananas
- 2 nanas
- 3 anas
- 4 nas
- 5 as
- 6 s

Suffix Array Example (2)

- Sort according to suffixes
- 3 anas
- 1 ananas
- 5 as
- 0 bananas
- 2 nanas
- 4 nas
- 6 s

Suffix Array

- Binary search finds item extremely fast
- Binary search is not trivial (see wikipedia.org)
- Searching a valid prefix will get an interval

- Generating suffix arrays is relatively fast
- Suffix arrays are not easily updatable
- Other sortings possible than alphabetical

Conclusion

- airspace-v.com provides aviation data
- Data is partially stored, partially retrieved
- Can be used for simulation or choosing routes
- No endorsement for navigation
- Edison: „Genius is one percent inspiration, ninety nine percent perspiration.“

Outlook

- Website is WIP (work in progress)
- Lots of extensions and improvements to come
- Validate data
- Introduce gamification - „been there, done that“
- Rework layout
- Can be used for other software – e.g. maps.me