Methods for the evaluation of mitigation measures

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With the contributions of: Yves Bas, Jean-François Julien, Flavien Charton & Cédric Braga

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Bats & Infrastructure

Uppsala, 28th November 2018

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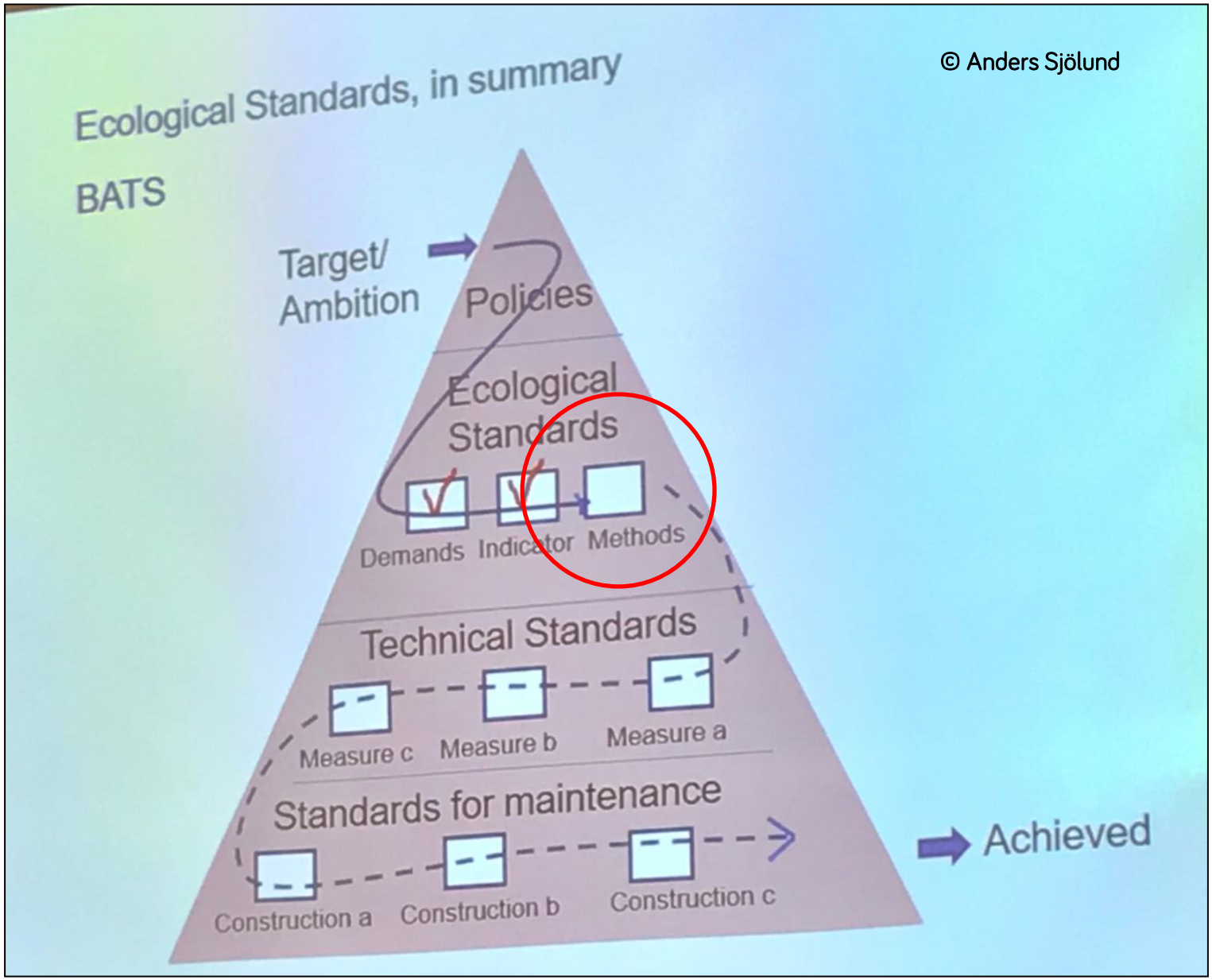
Ecological Standards, in summary
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BATS
Target/
Ambition
Policies
Ecological
Standards
Demands
Indicator
Methods
Technical Standards
Measure c
Measure b
Measure a
Standards for maintenance
Construction a
Construction b
Construction c
Achieved

Method 1: Acoustic Flight Path Reconstruction (AFPR)

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RESEARCH ARTICLE

Journal of Applied Ecology
BRITISH ECOLOGICAL SOCIETY

Bat overpasses: An insufficient solution to restore habitat connectivity across roads

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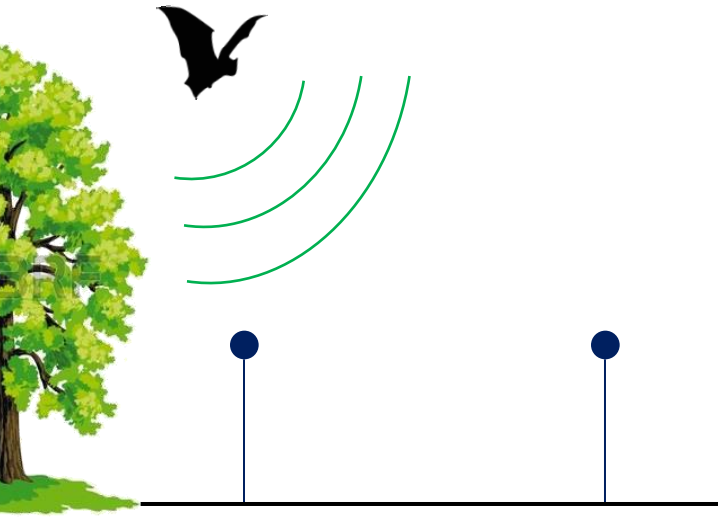
https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.13288

- Linear Transport Insfrastructure (LTI) :
  - Roads
  - Railways
  - Where?
    - without structure
    - wildlife crossings
    - bridges, culverts
    - hop-overs
    - bat overpasses (e.g. gantries), etc

- Windfarms

- Bat localisation on one plane
- Recording whole the night
- In addition of visual observation
- Examples:
  - Do bats cross the road?
  - Do bat flight at risk collision?

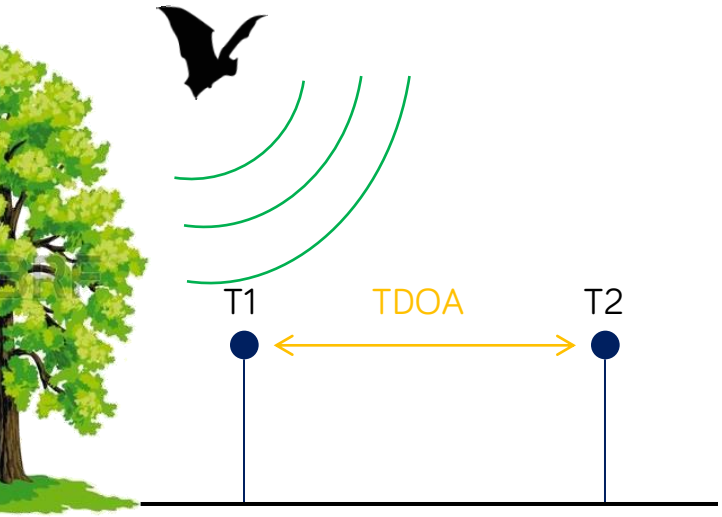
- TDOA = Time Difference of Arrival Time

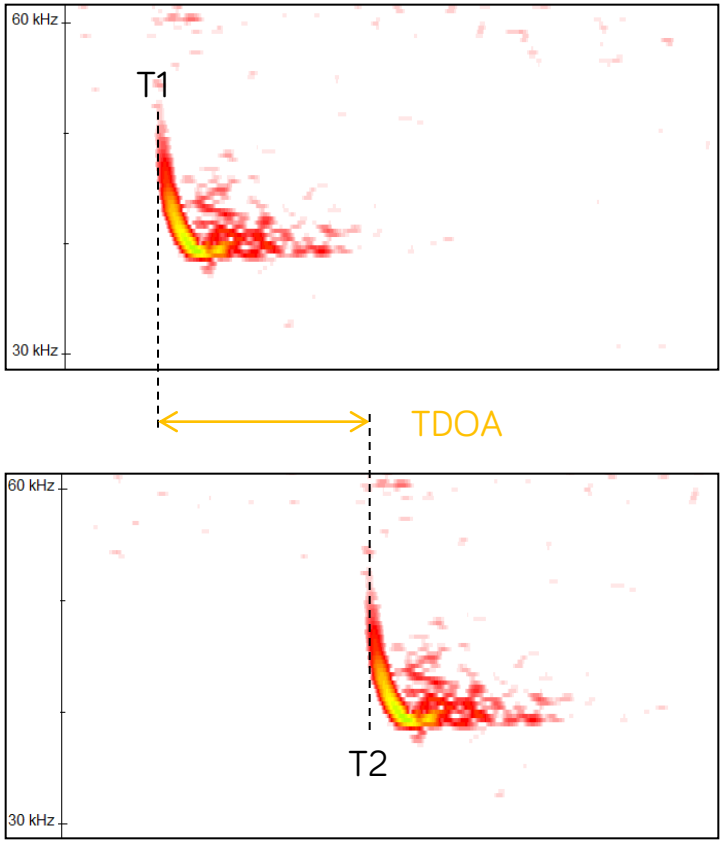


Sound speed=340m.s-1

TADARIDA software toolbox
https://github.com/YvesBas
https://github.com/FabienClaireau

- TDOA = Time Difference of Arrival Time





Mic. 1

Mic. 2

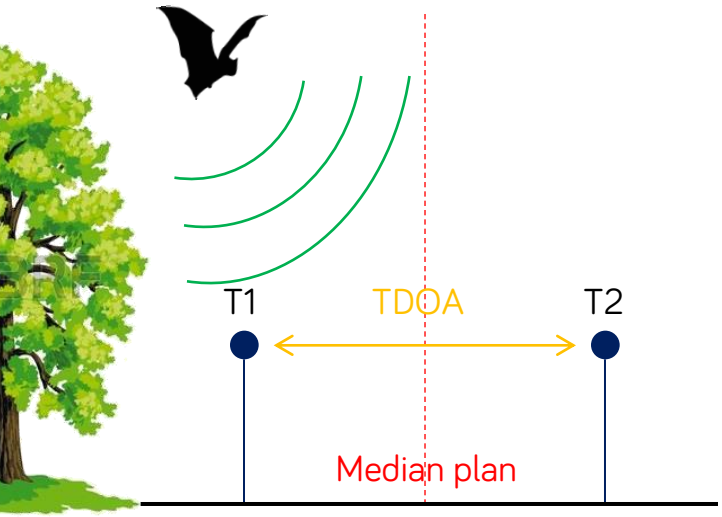
Sound speed=340m.s-1

T1=arrival time of the call on mic. 1

T2=arrival time of the call on mic. 2

Time difference of arrival=T2-T1

- TDOA = Time Difference of Arrival Time



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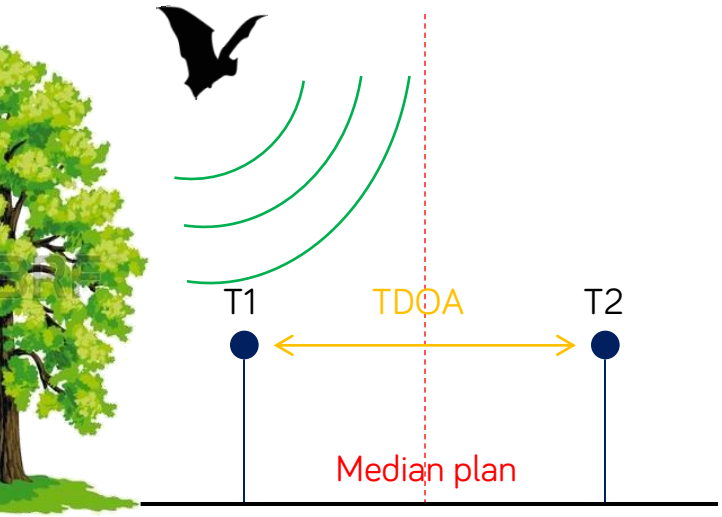

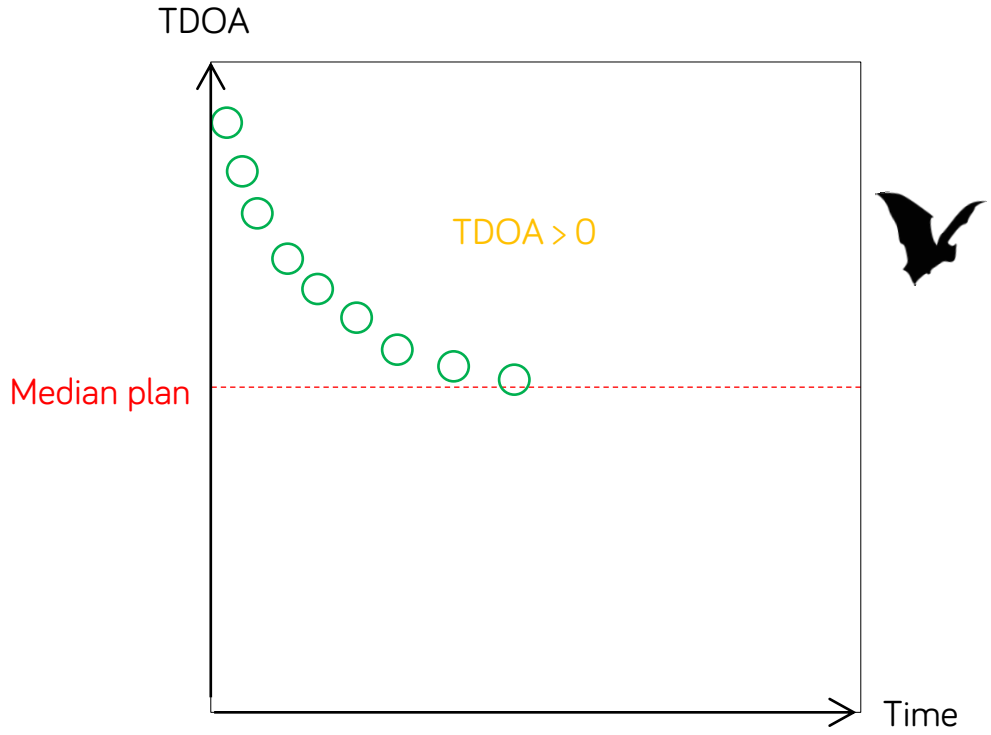

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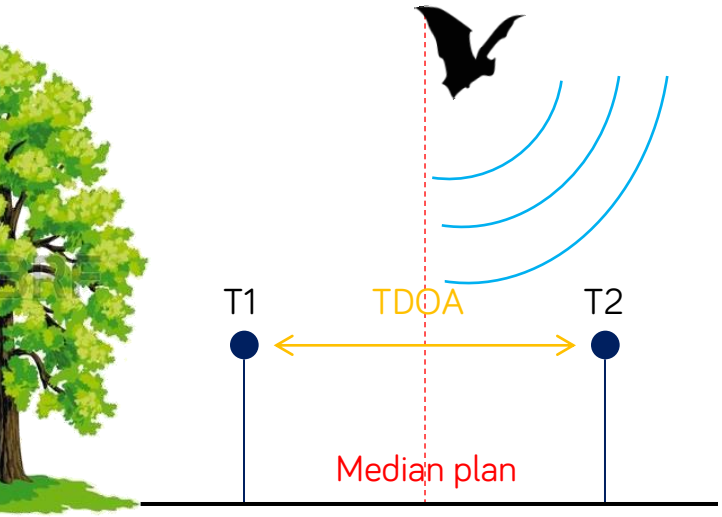
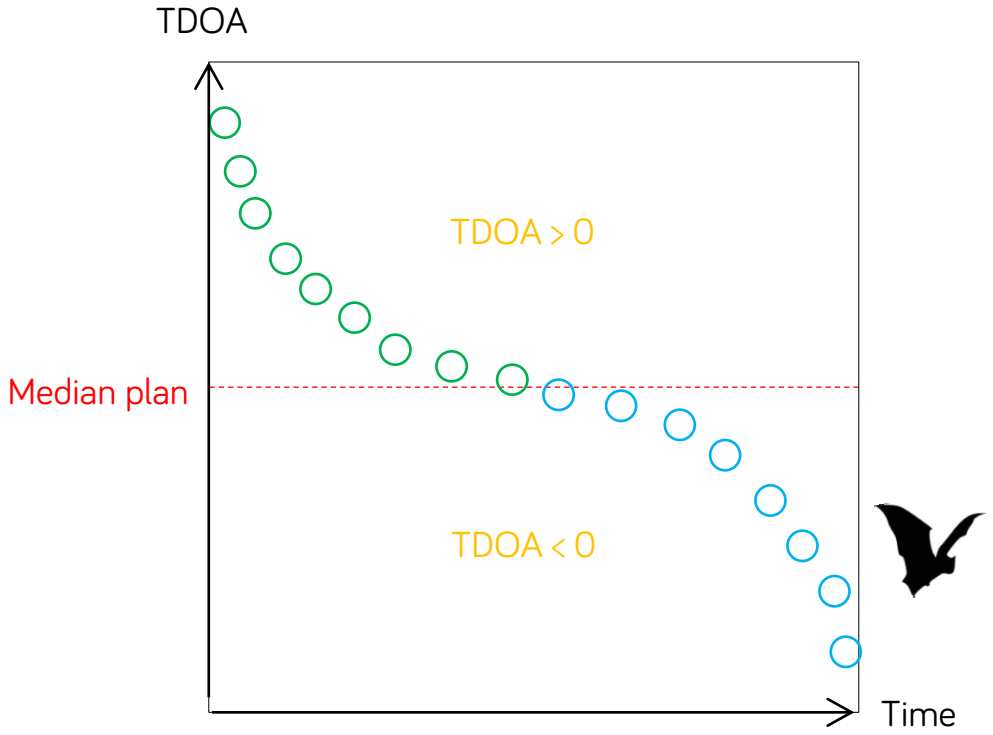




Sound speed=340m.s-1

T1=arrival time of the call on mic. 1

T2=arrival time of the call on mic. 2

Time difference of arrival=T2-T1

- Acoustic recorder in stereo recordings (e.g. Song Meter Bat+ 2 or 3)
- Same microphones model on each channel
- French configuration if you use Tadarida software :
  - http://vigienature.mnhn.fr/page/protocole-point-fixe
  - Upload at the bottom of the page
  - Use the « stereo » config (change geolocalisation)
- If you used another configuration, used the two channels for recordings

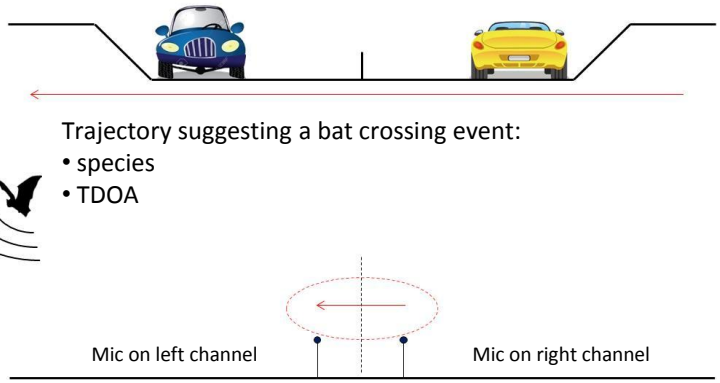
- Rule decision for the placement of microphones:
  - For LTI :
    - Mic on left channel (number 0) facing the road
    - Mic on right channel (number 1) facing the habitat
  - For windfarms:
    - Mic on left channel (number 0) on the ground
    - Mic on right channel (number 1) at the high altitude

- Note the spacing between microphones
  - For LTI: 4 m maximum

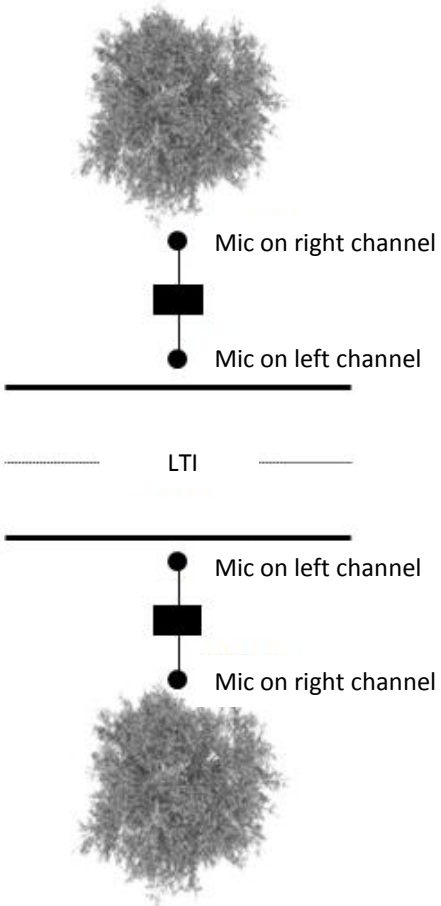
- Prefer clear areas

- At the closest of the LTI

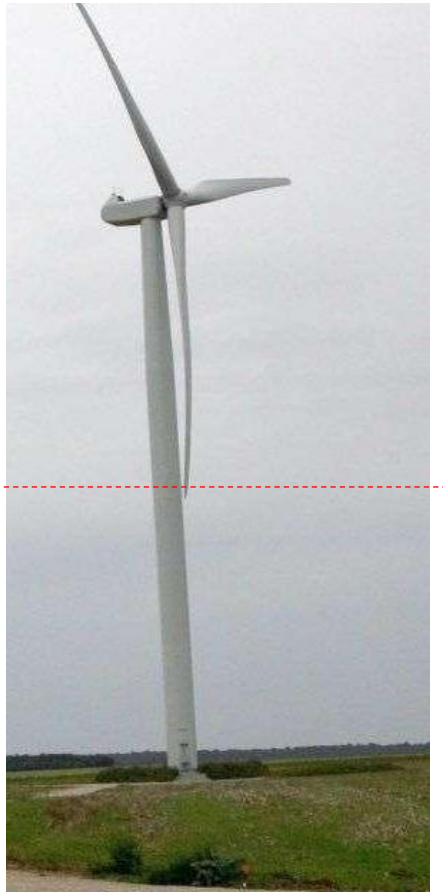
Examples: bridges, culvert...
With one acoustic recorder & 2 microphones



Examples: without structure, wildlife crossings, bat overpasses
With 2 acoustic recorders & 4 microphones



ACOUSTIC FLIGHT PATH RECONSTRUCTION (AFPR)
TDOA interpretation (Wind farms)



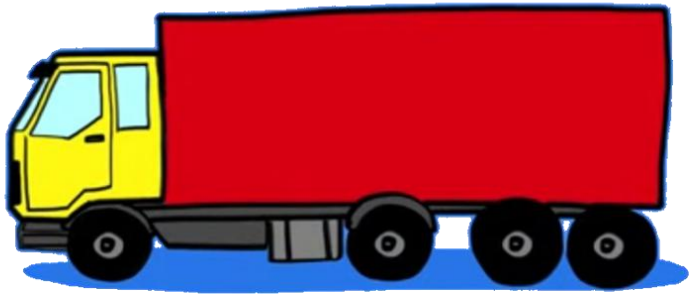
Mic on right channel

TDOA > 0

Median plan

TDOA < 0

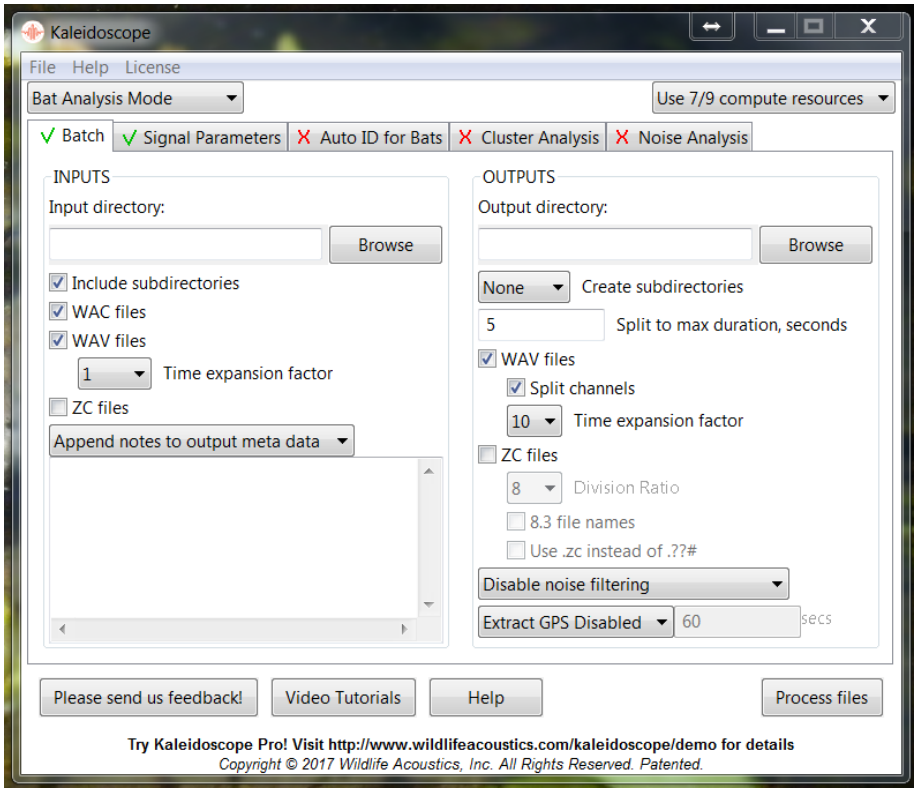
Mic on left channel



- If you want to use Tadarida software:
  - Free
  - Inscription: https://vigiechiro.herokuapp.com/#/accueil
  - Regular update
  - Allows unlimited storage of your data
  - Manual of protocol (« point fixe », in French (sorry!)) : https://drive.google.com/file/d/0B5ZM90wrDzUOaUxKYTRHek91bWM/view

- If you use Tadarida: rename with Lupas Rename (see tutorial in French (sorry again!))

- Decompression with Kaleidoscope



- Create files *.TA with TadaridaL (free)
  - Upload here: https://github.com/YvesBas/Tadarida-L/releases/download/v1.0.2/install_TadaridaL.exe

- If you use another software:

- Convert your file containing identifications in *.txt file with the columns below:

Description	Tadarida	SonoChiro	Need your help for another
ID of your point	participation	You must create an ID by point and a column in your file with this ID for each line	Please send me email with a file containing species identification (Kaleidoscope, …)
species	espece	Espece	
confidence index (score/probability)	probabilite	Isp	
time of start of cries	temps_debut	*	
time of the end of cries	temps_fin	*	
frequence	frequence	Fdom	

*Use in *.TA files generated by Tadarida-L the columns:
- "StTime" for "temps_debut"
- "Dur-StTime" for "temps_fin

1/ This R script is to be able to pair two microphones connected on the same acoustic recorder and to locate the position of bats (direction in particular):
https://github.com/FabienClaireau/Pairing_microphones

Then, if you want define a bat crossing event, you have a two choices :
- if you have synchronized acoustic recorders: go to 2a
- if you have non-synchronized acoustic recorders: go to 2b

2a/ If you want define bat crossings and if you use 2 acoustic recorder non-synchronized, you must use: https://github.com/FabienClaireau/Automatic_calculation_of_the_time_shift
https://github.com/FabienClaireau/Find_bat_road_crossings

2b/ If you want define bat crossings and if you use 2 acoustic recorder synchronized, just use: https://github.com/FabienClaireau/Find_bat_road_crossings

If you want characterize bat risk collision at wind farm, just use the script 1

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Please acknowledge structures and research article in your papers if you use this script

If you want to use this method with another software, send me a email with the file containing species identification

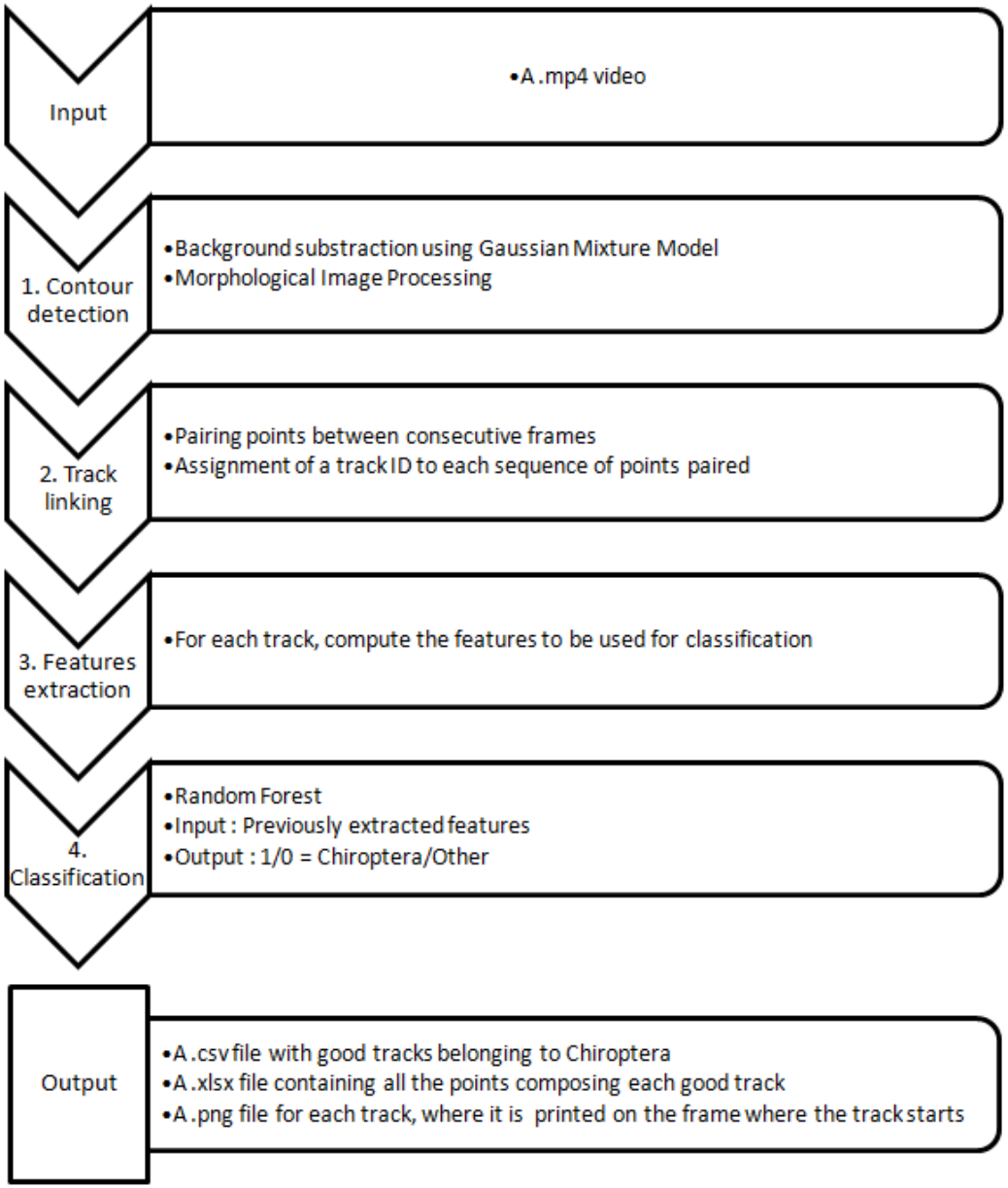
Method 2: Bat Tracking Toolbox (BBT)
Use of thermal camera

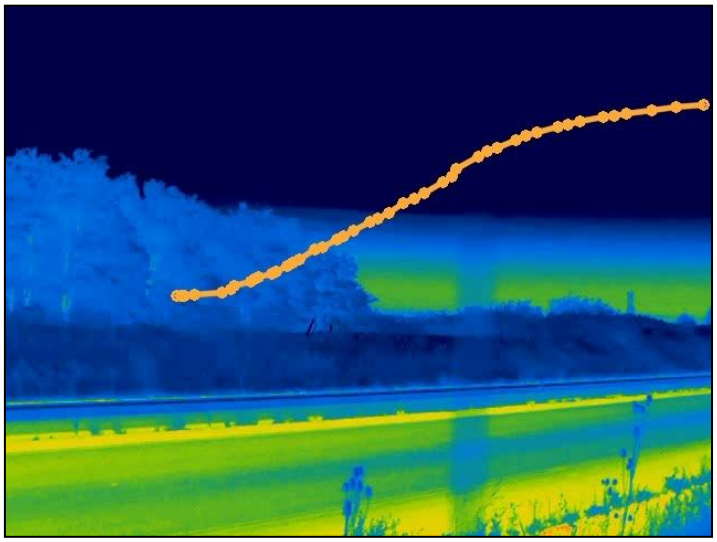
To analyze the recordings video by camera with manual checking is:
- too long
- very cost

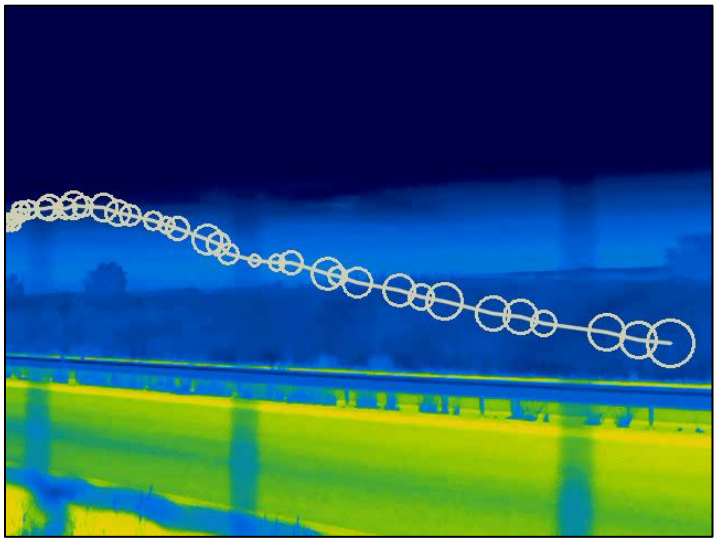
And thy are associate bias in these analyzes (subjectivity, experience …)
⇒Limit comparison for before/after studies for example

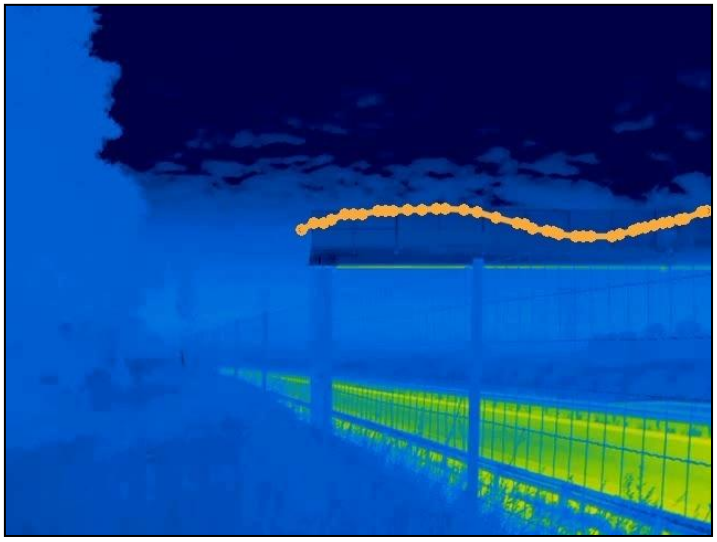
Development of an automatic toolboox (BTT) in order to:
-reduce time
-reduce cost
-gain in term of data collected (it is possible to have a « big data »)
-without bias observatory and link to measures (flight height, relative speed …)
-establishment of a reproducible method standardised permit to meta-analyzes with many study case

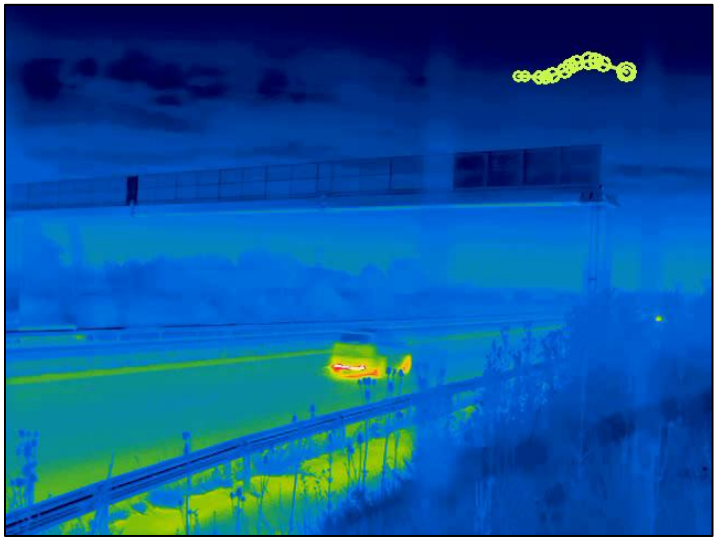
Manuscript in preparation !


Input
•A .mp4 video
1. Contour detection
•Background substraction using Gaussian Mixture Model
•Morphological Image Processing
2. Track linking
•Pairing points between consecutive frames
•Assignment of a track ID to each sequence of points paired
3. Features extraction
•For each track, compute the features to be used for classification
4. Classification
•Random Forest
•Input : Previously extracted features
•Output : 1/0 = Chiroptera/Other
Output
•A .csv file with good tracks belonging to Chiroptera
•A .xlsx file containing all the points composing each good track
•A .png file for each track, where it is printed on the frame where the track starts









Bat worker *versus* BTT

	Manual checking (fieldwork and office)	**Bat Tracking Toolbox (BTT)**
Number of bats detected by bat worker	193	150/193
Number of bats no detected by batworker	No concerned	75
Total of bats	193	225
Time		
Fieldwork	36 hours	36 hours
Office	42 hours (6 days)	< 14 hours (2 days)

Bat Tracking Toolbox permit:
- to win time, reduce cost and eliminate bias
- to characterize flight behaviour
- to detect species which are difficult to detect on acoustic such as *Rhinolophus* sp.
- to detect more bat crossings above road than manual checking

Perspectives:
- establish automatic bat flight height

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THANK YOU!


Christian Kerbiriou


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Nathalie Machon


Benjamin Allegrini


Yves Bas


Flavien Charton


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