



# HAWK

## Finish gliding day

Celje (15/03/2025)

Erazem Polutnik



- **History**  
(about variometer, how does it work and what do glider pilots want to have)
- **HAWK development**  
(elevator, complexity, meeting prof. Meyr in dr. Peng)
- **HAWK usage**  
(parameters, why two needles, too optimistic, AOA)
- **Future**  
(speed polar, looking forward future)

Part 1

# History



# Human



# Air

Pressure is decreasing with altitude.

Winter, Sage, Bohli (**flow variometers**)

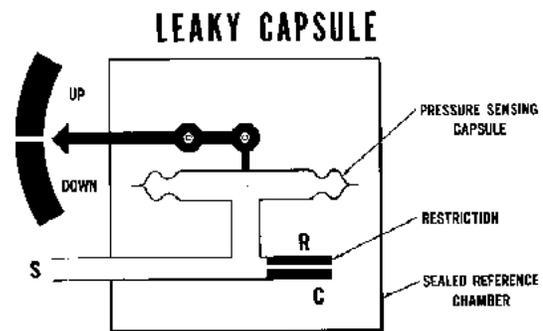


Figure 2

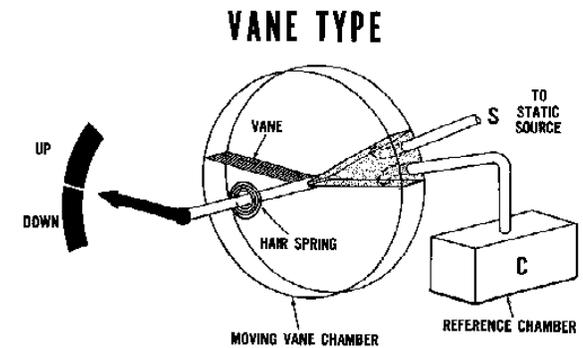


Figure 3

# TE compensation

Total energy = kinetic energy + potential energy

## MOORE-SCHUEMANN TOTAL ENERGY COMPENSATOR

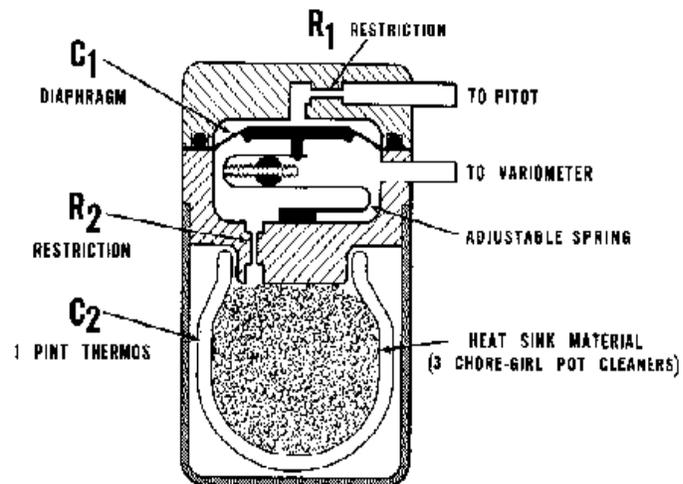
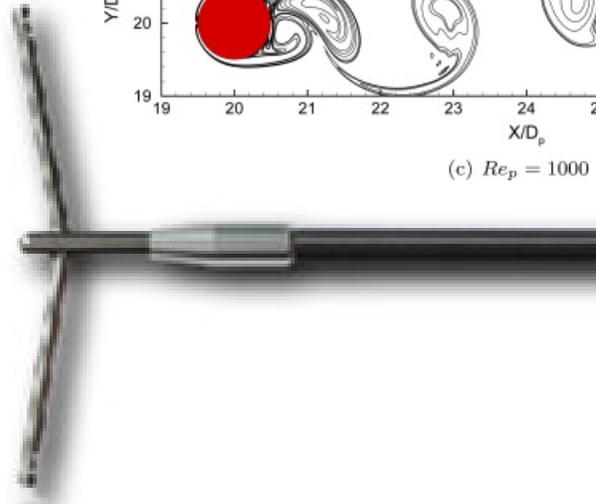
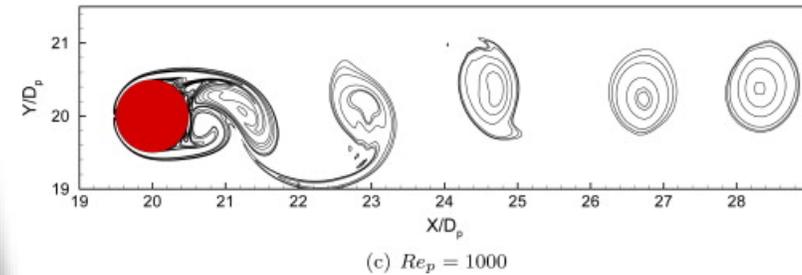


Figure 11

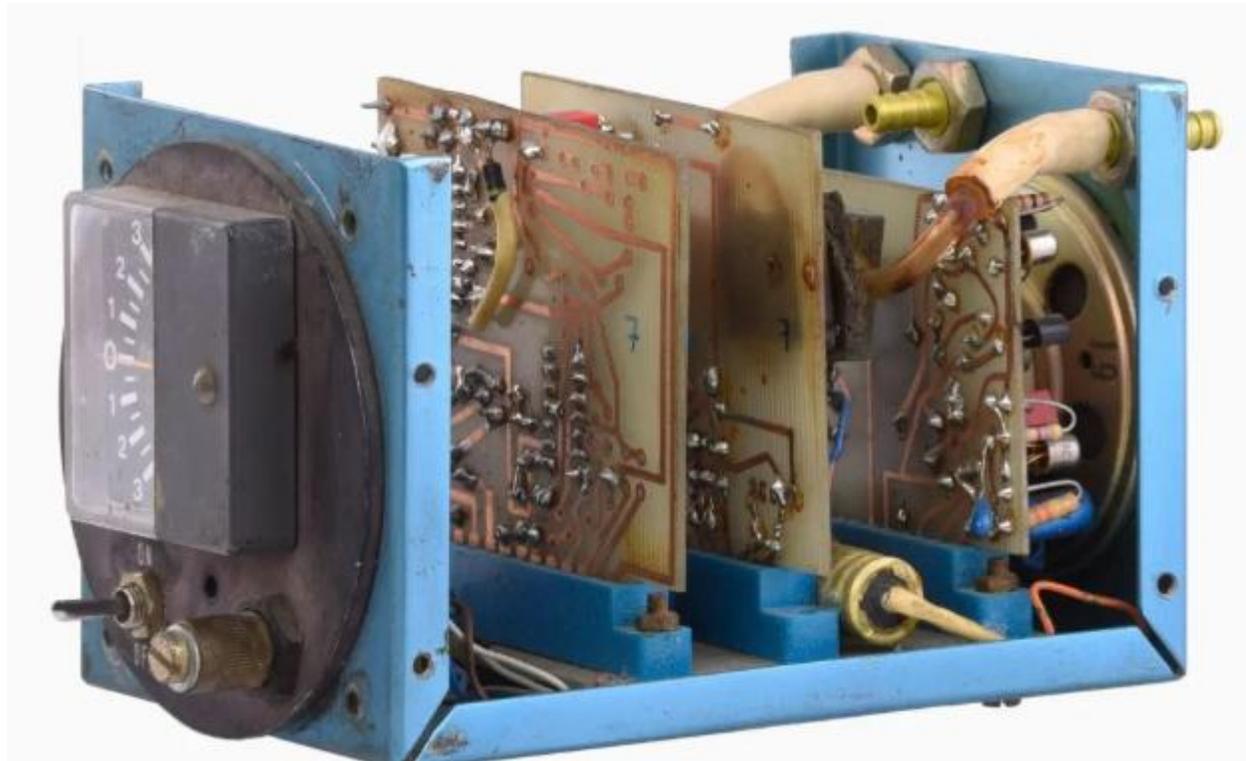
Capilar



TE tube

# Electricity

Črt Rojnik, EV-82, LX500, LX1000 (**flow variometer**)



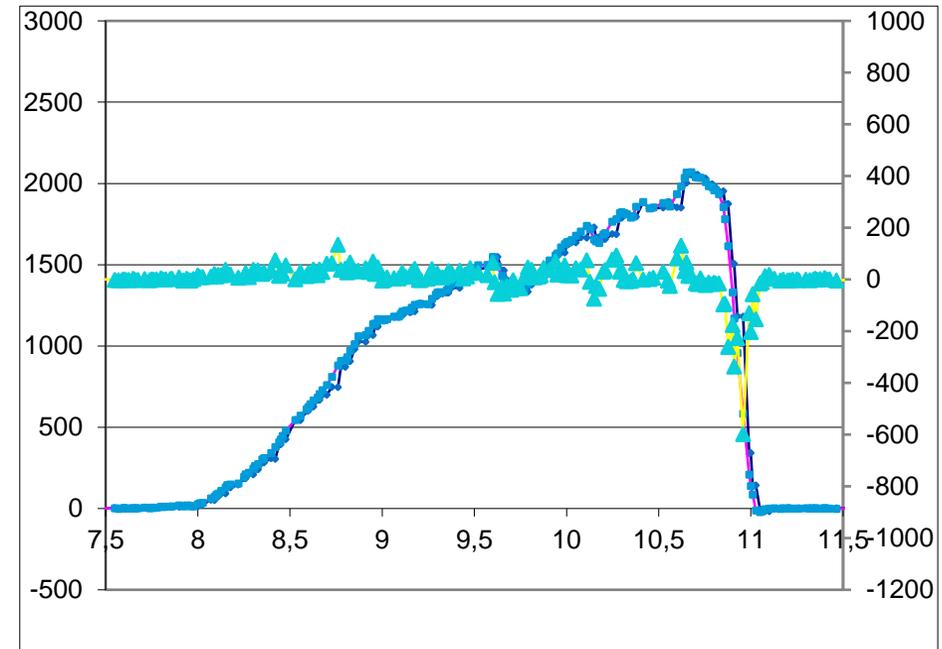
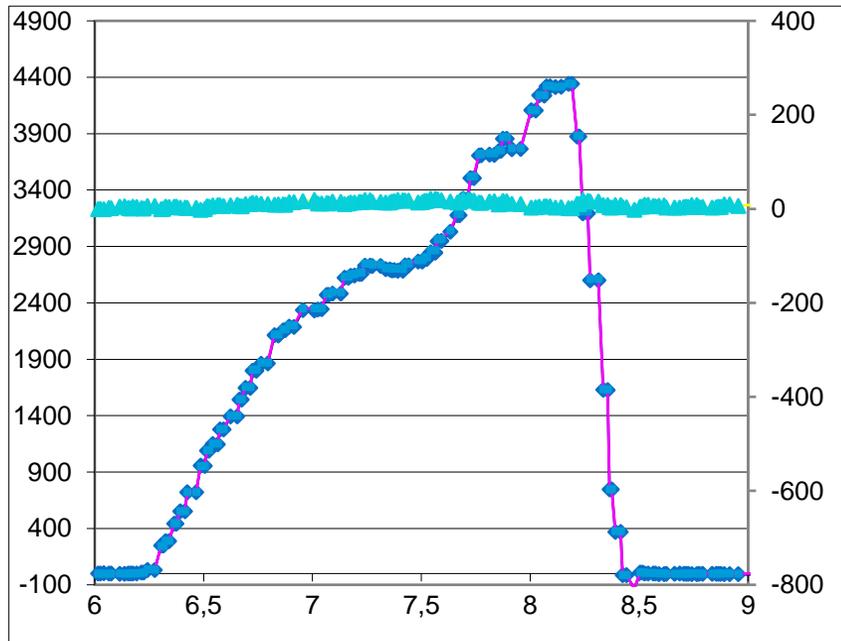
# Digital

LX5000VU, ZS1, CAI302, EOS, V5, V7, V9 (pressure)



# Digital II

## Electronic compensation



# The box

Vertical speed is calculated from altitude difference

$$w = (h_2 - h_1) / (t_2 - t_1)$$

However, it could be calculated also from acceleration

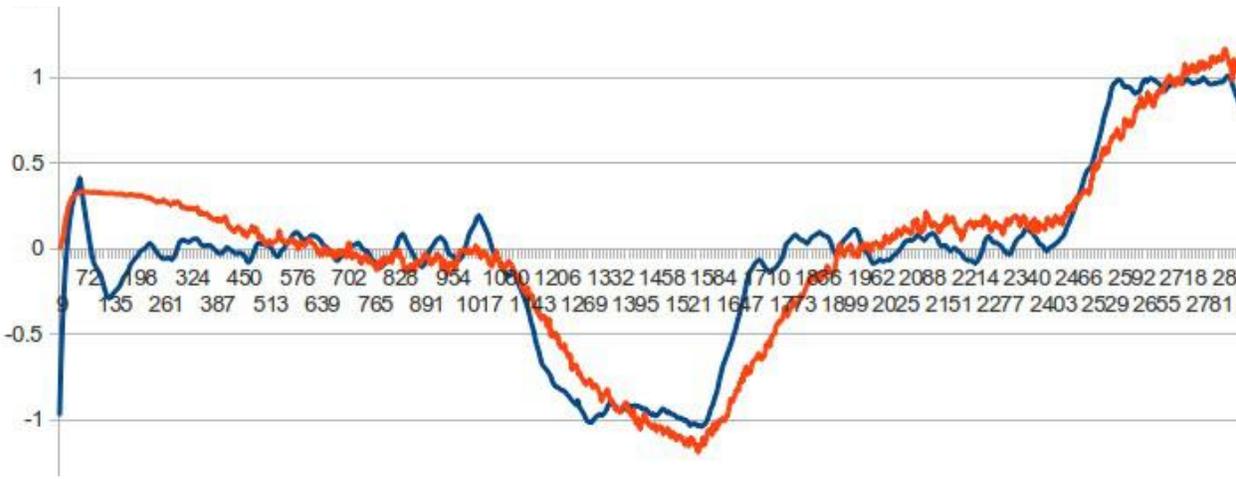
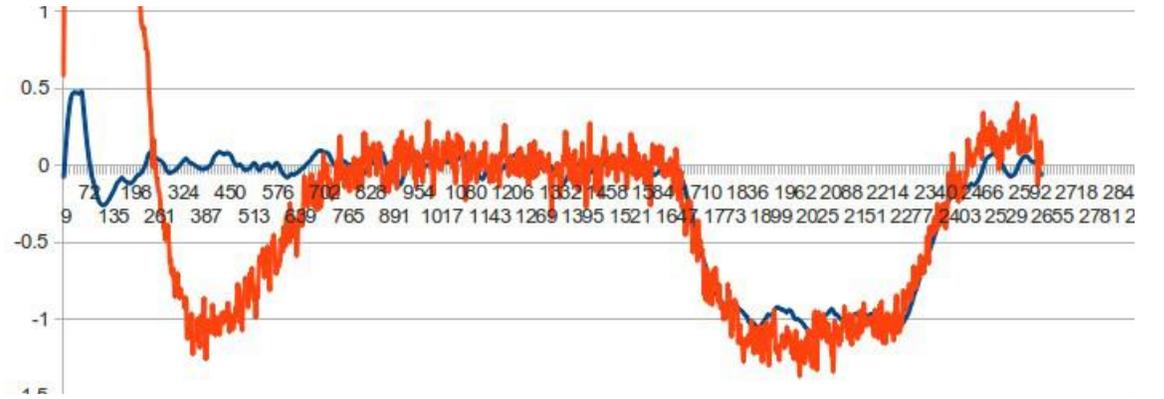
$$w = w_0 + a(t_2 - t_1)$$

Part 2

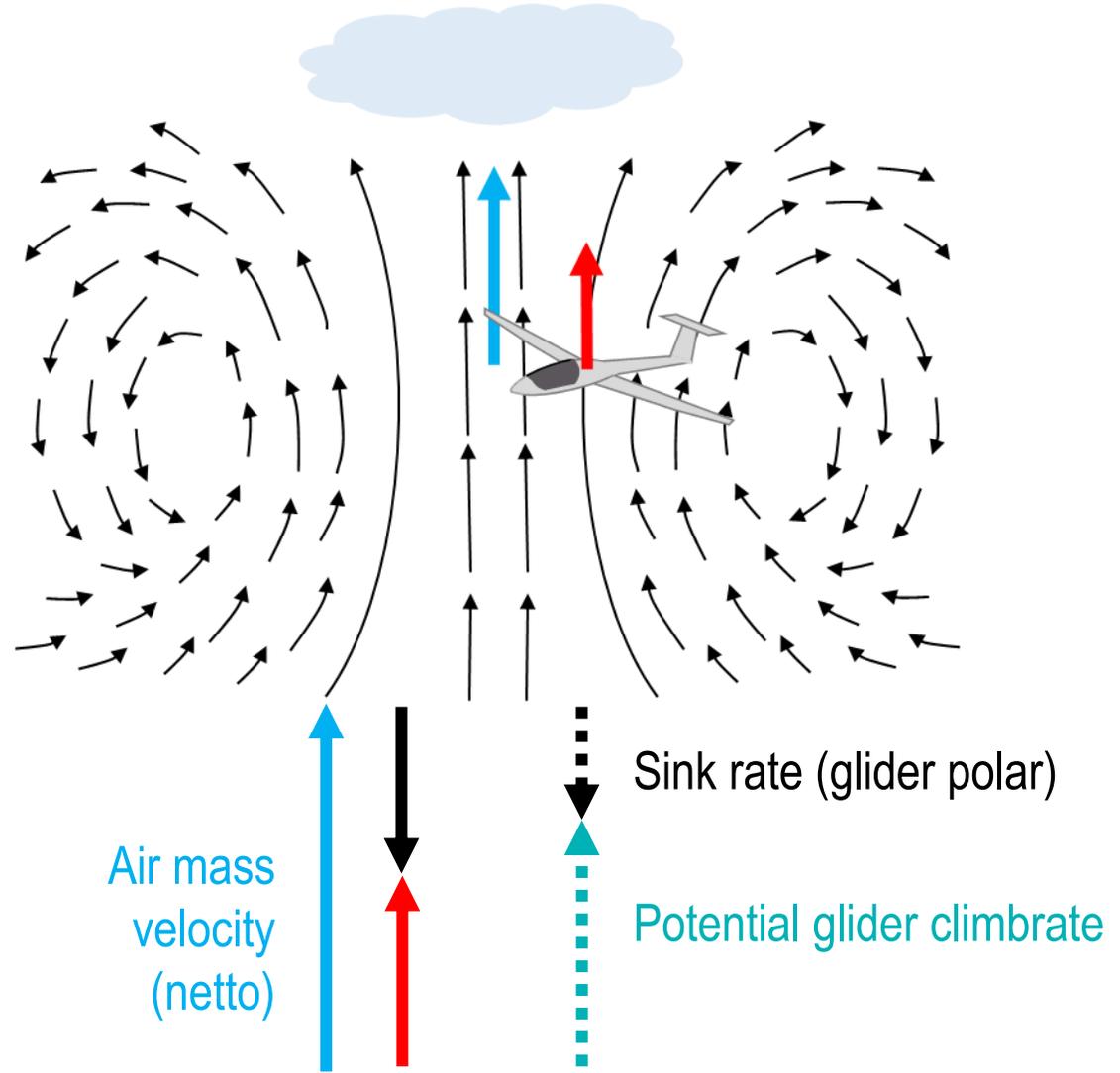
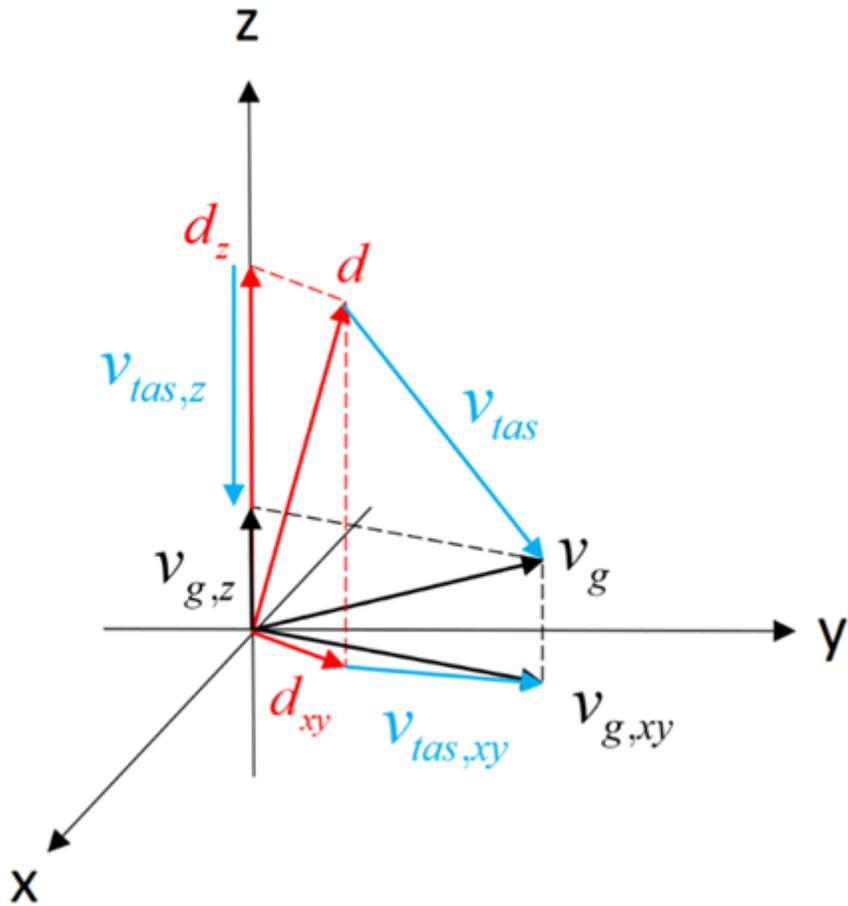
# HAWK development



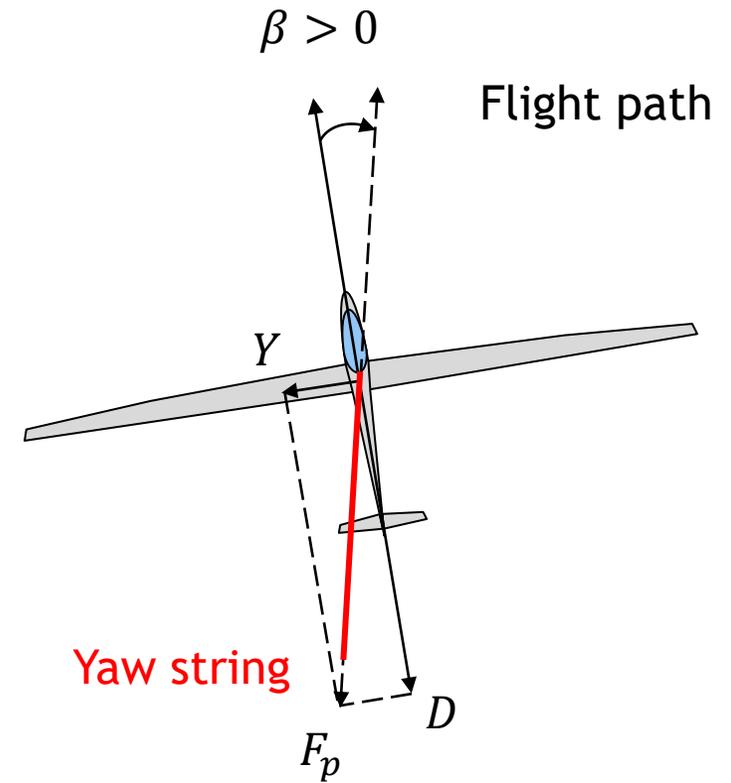
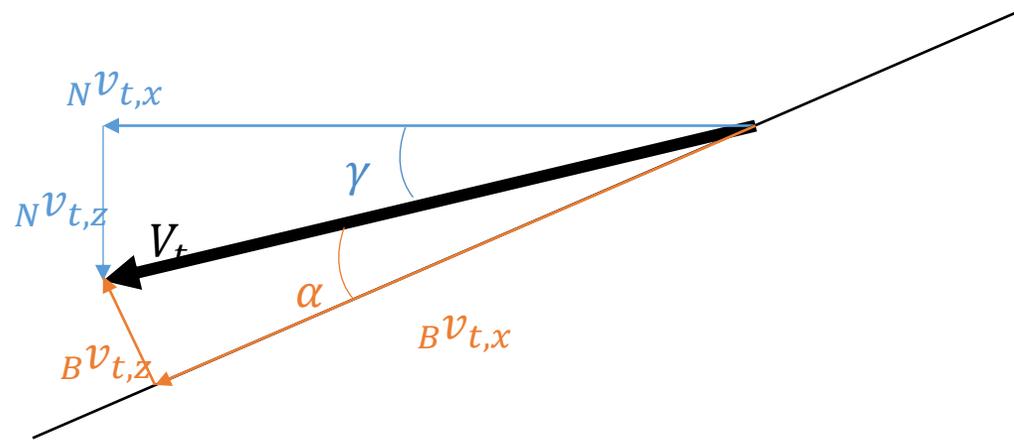
# Elevator



# Complexity

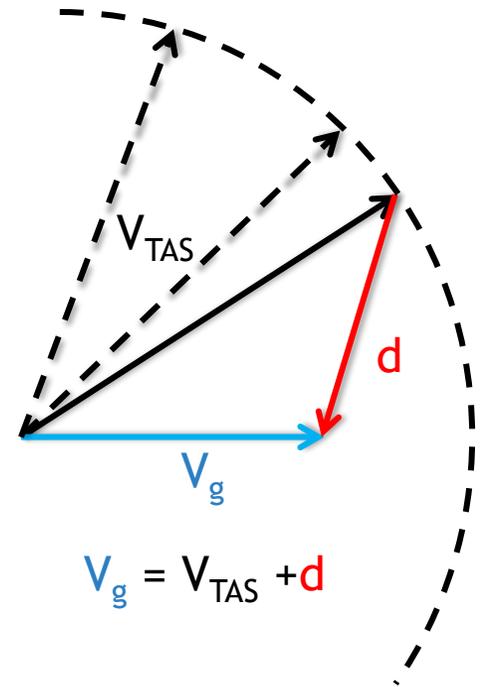


# Complexity II



# Complexity III

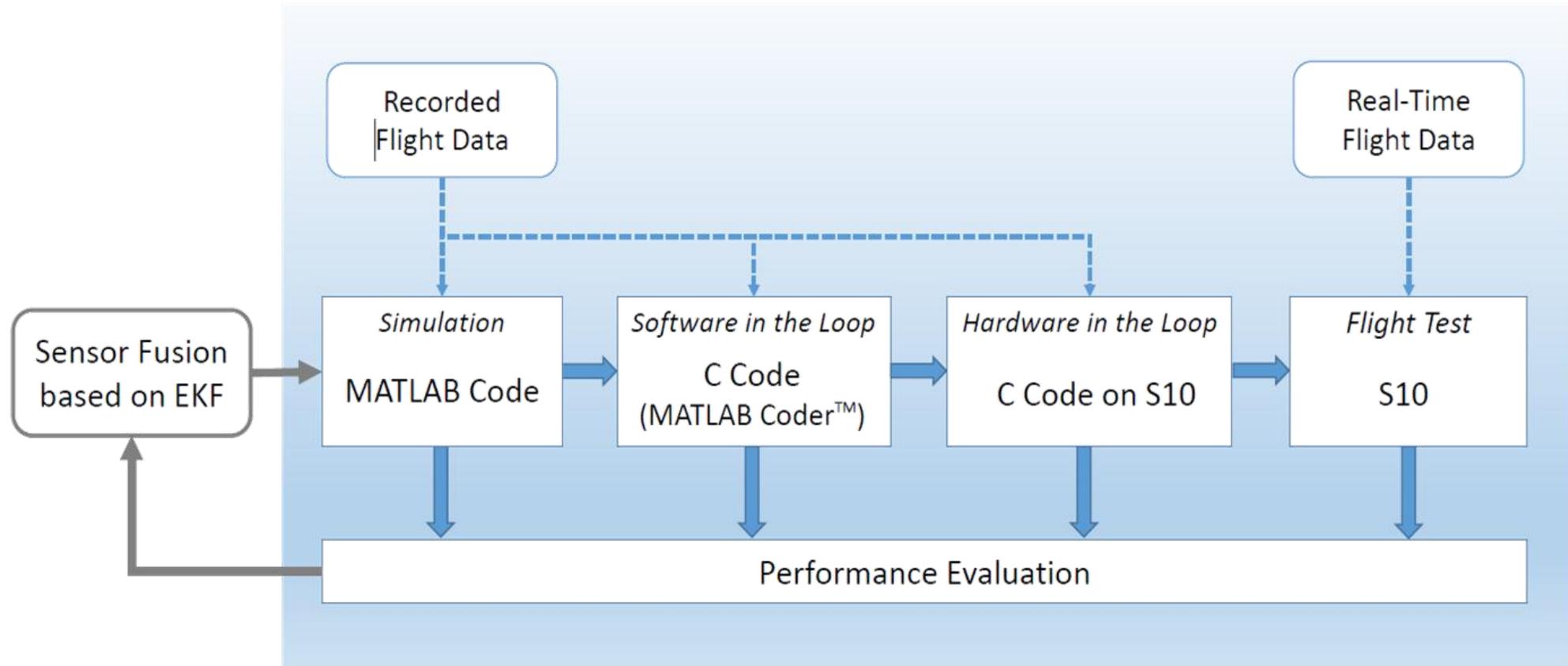
If you only know the length of TAS but not the direction.



# Meeting

- Prof. Heinrich Meyr and dr. Peng Huang 2016
- Measurement principle  
Estimates the true air mass movement known as “netto vario” using an “extended Kalman filter”
- Information  
Dynamics of 3-dimensional air mass  
Output is “netto vario”  
“Vario” is derived from “netto vario” by subtracting the sink rate of the circular polar.  
“Relative vario” equal “netto” - min sink rate

# Development



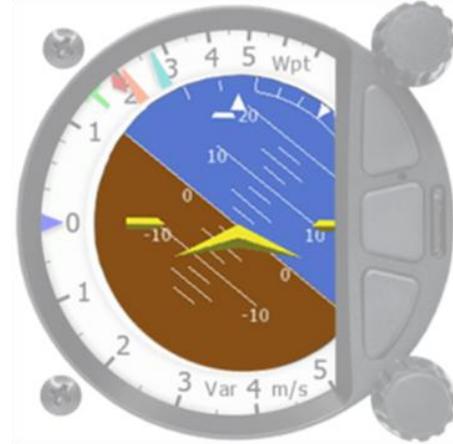
# Result



Developed by prof.dr Henrich Meyr and Peng Huang. Integrated exclusively in LXNAV products.

## Highlights

- Ignores horizontal gusts
- Detects thermals reliably with early warning
- Horizontal wind is in real time

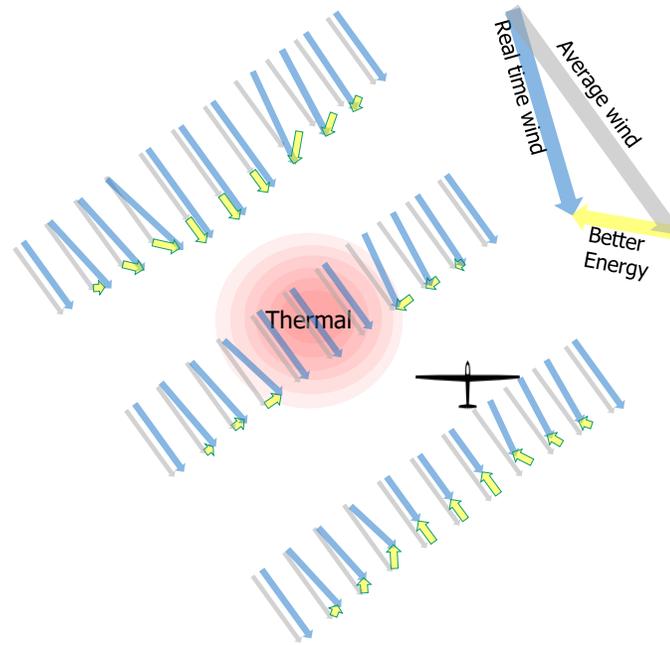


## Part 3

# HAWK usage



# Indication

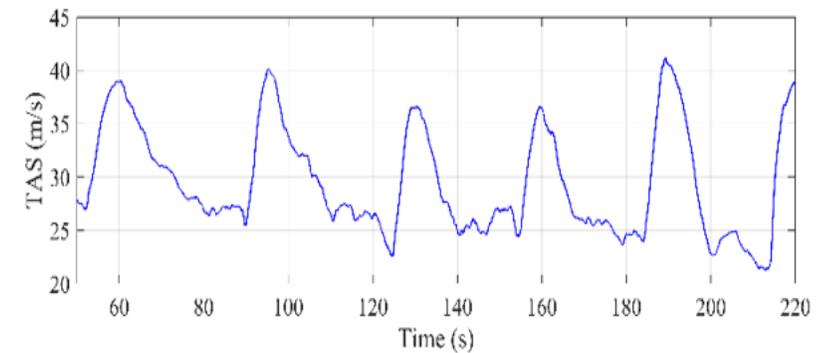
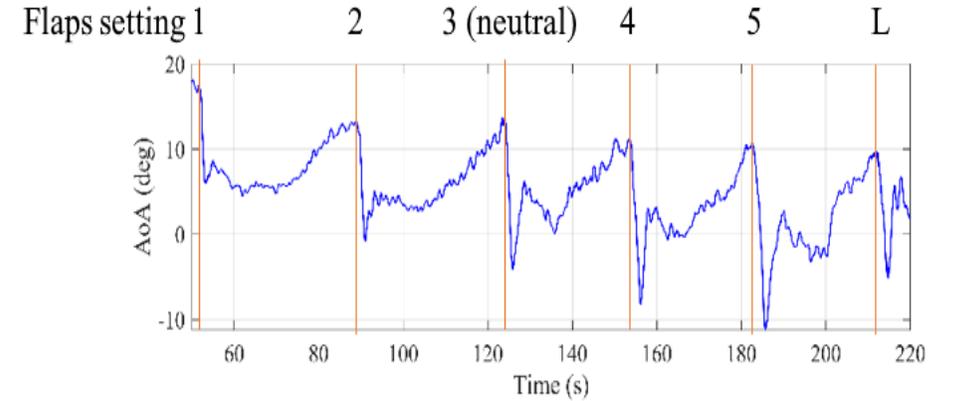
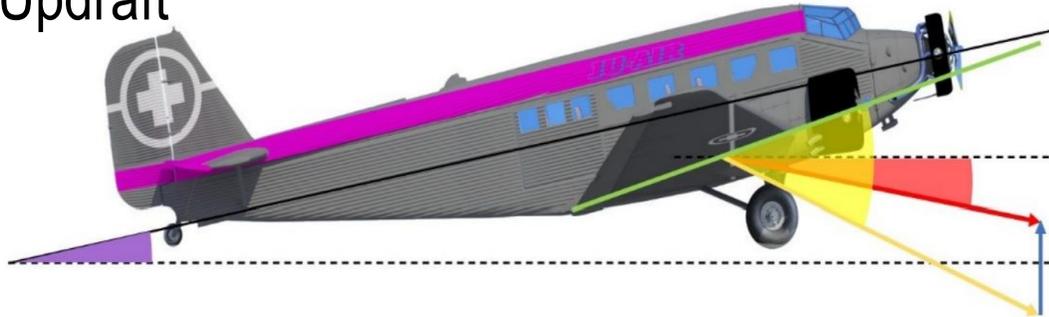


# Angle of attack - AOA

Downdraft



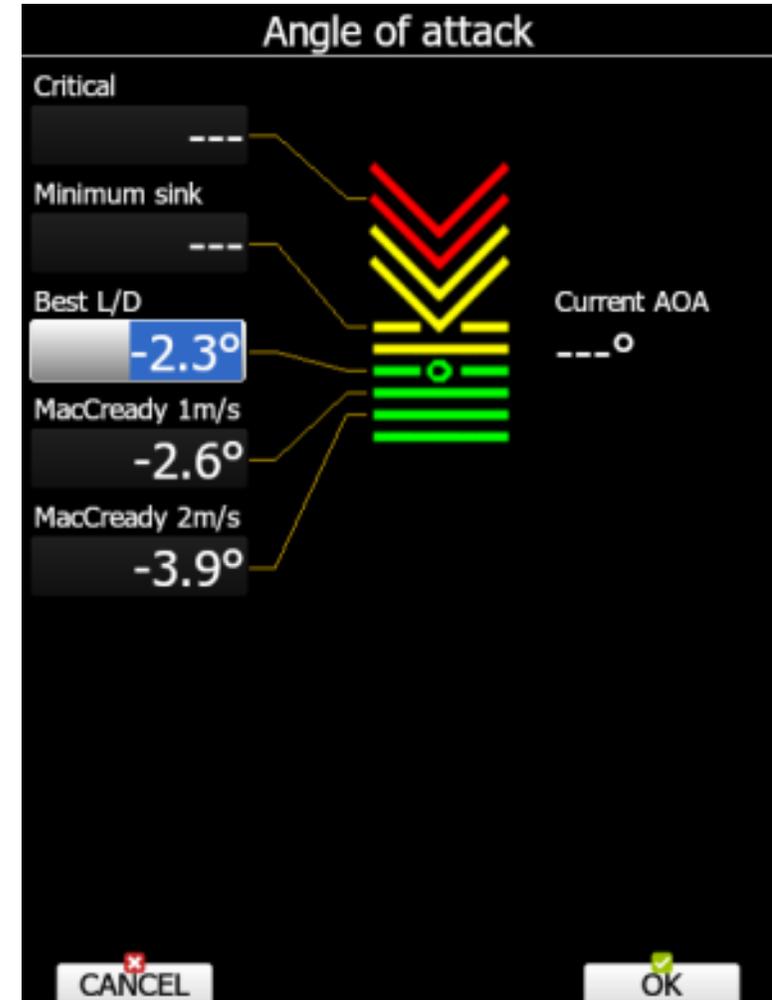
Updraft



Swiss Transportation Safety Investigation Board STSB, SUST report 2370



# Angle of Attack II



# Setup

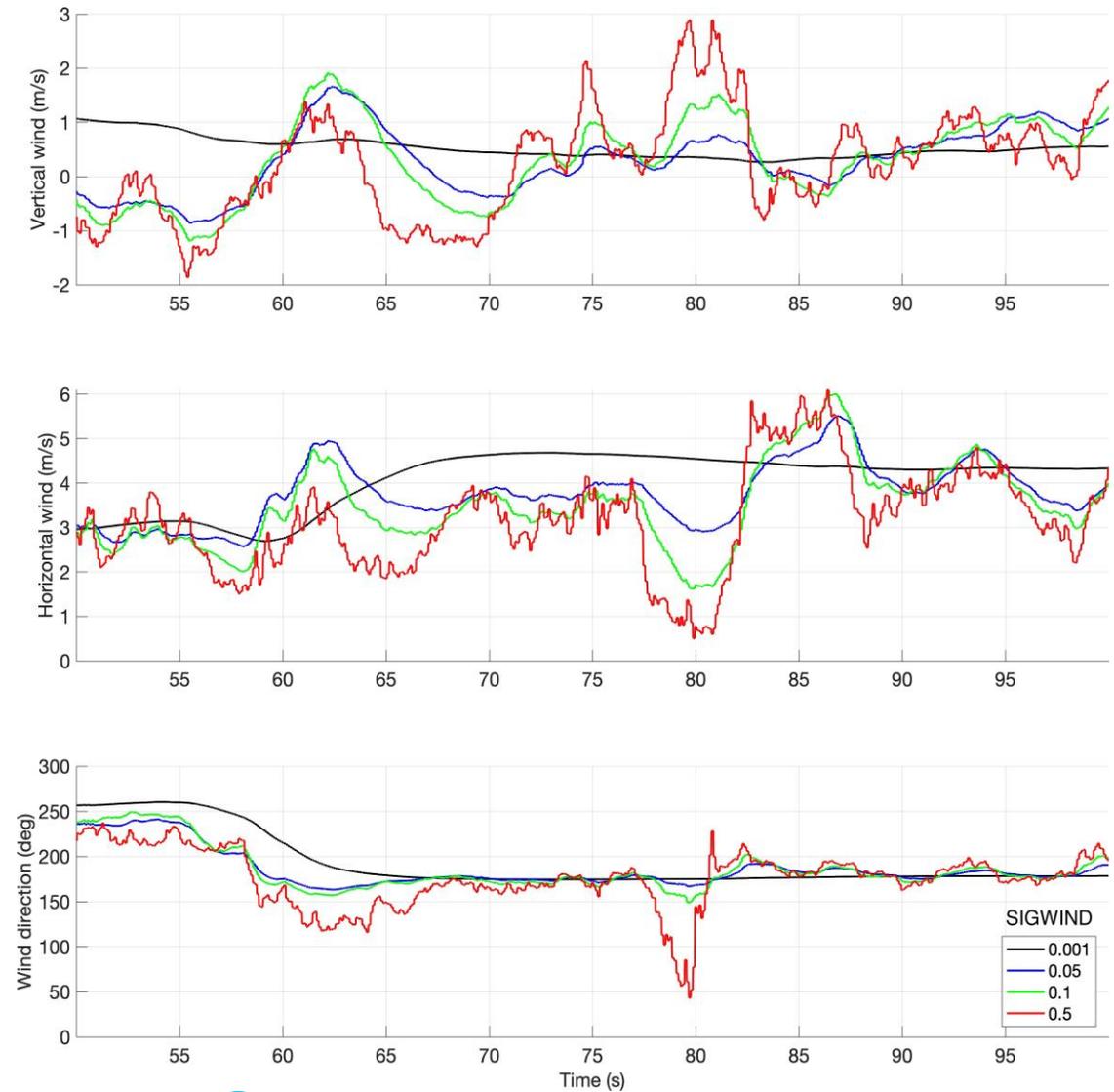
Wind variance

Horizontal wind average

Vertical wind average

Vario Parameters		
Vario needle filter	Vario sound filter	Vario range
1.5sec	1.5sec	5m/s
HAWK		
<input checked="" type="checkbox"/> Enabled		
Wind variance	Wind avg. hor.	Wind avg. ver.
0.05	20.0	3.0
SC tab	Integrator time	Auto SC
1.0m/s	20sec	OFF
Smart vario filter	Beep at max	Beep before max
OFF	OFF	3.0s
<input type="checkbox"/> Auto reset integrator		
Netto filter	SC filter	Relative filter
0.2sec	1.5sec	1.5sec
Netto time		
20sec		
<input type="button" value="CLOSE"/>		<input type="button" value="EDIT"/>

# Wind variance



# Setup - Indicator

Two needles

Nonlinear dial style

SC needle, recommended netto

V8 indicator Sn.:00668

Vario needle	SC needle
Vario	Netto
Needles	Navboxes displayed
Vario & Hawk	4
First line	Second line
TAS	IAS
Third line	Fourth line
Altitude (m)	Netto
Symbols	
No bar	No diamond
<input type="checkbox"/> MacCready	<input type="checkbox"/> Thermal
Speed tape	<input type="checkbox"/> Flarm
Dial Style	Needle style
Linear	Thick
Background	
White:Black	

# Setup - Audio

Audio source

SC mixed

Vario audio mode

Switching between Vario/SC mode



# Installation

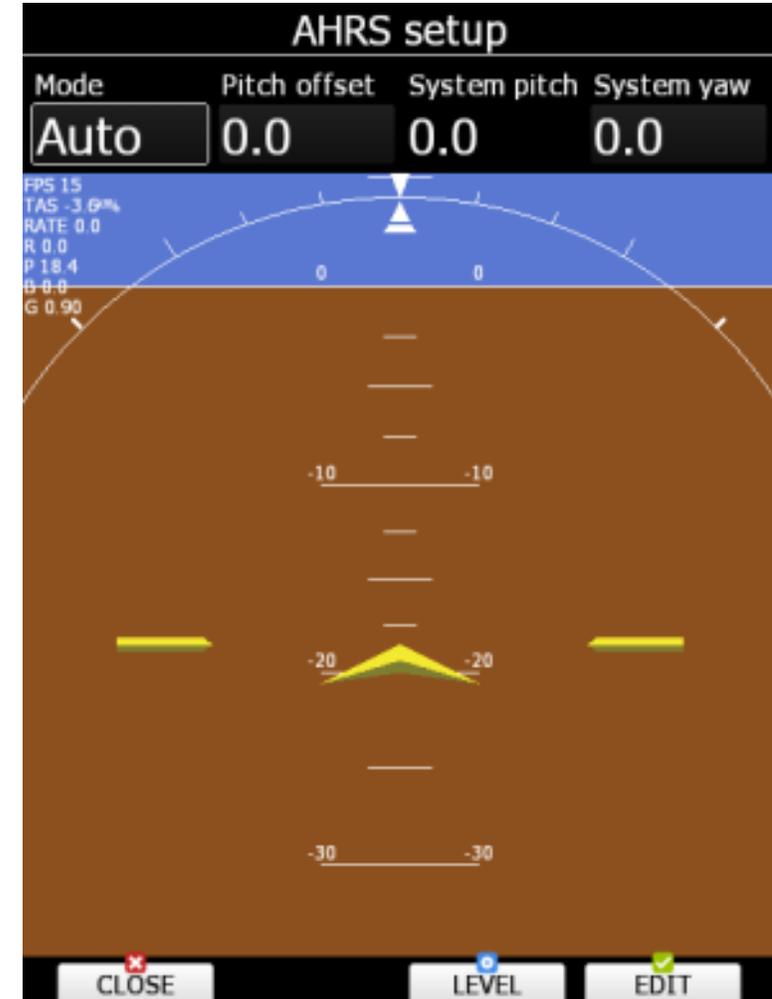
Levelling is crucial for proper operation of HAWK

Passwords:

1043 – airspeed offset

1045 – gyro alignment

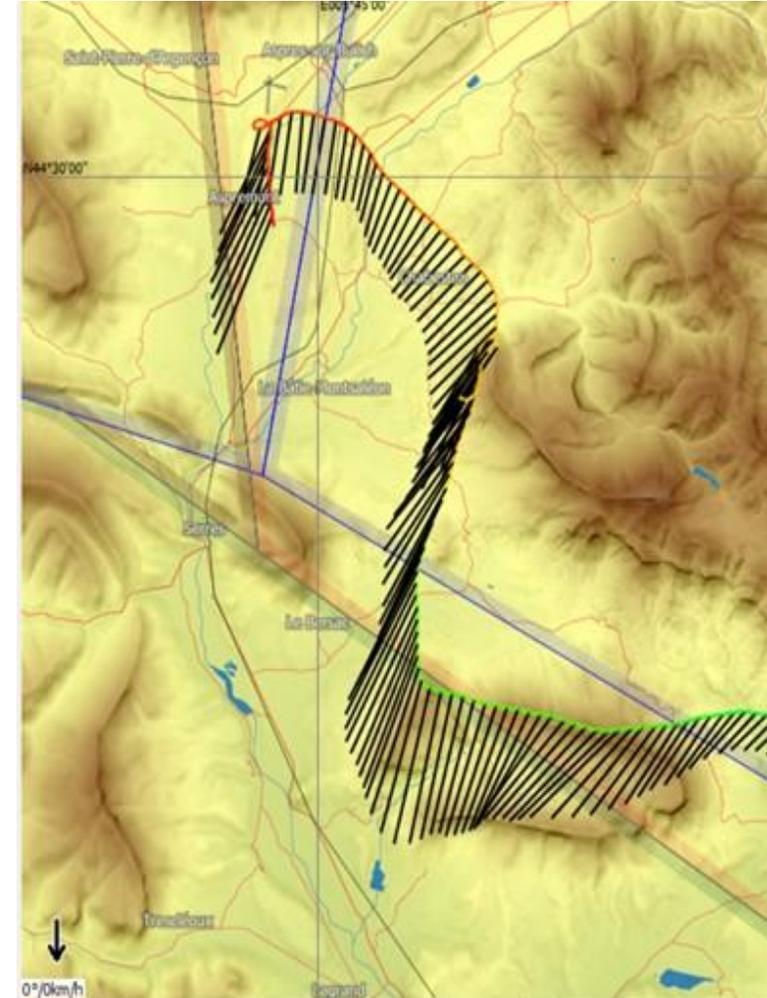
???? – acc. alignment



# Analysis

Most of HAWK parameters stored in IGC file. You can use SeeYou to evaluate them.

Passwords:  
43002 – HAWK recording



# Free trial

Try HAWK for three months

<https://gliding.lxnav.com/hawk-demo-request/>

The screenshot shows a web browser window with the URL <https://gliding.lxnav.com/hawk-demo-request/>. The page title is "HAWK Demo Request". At the top, there are two tabs: "LX90xx Devices" and "S10x Devices", with "S10x Devices" being the active tab. Below the tabs, there is a paragraph of text: "The HAWK option is presently available for **GEN4** or newer navigation systems (LX80xx, LX90xx) with V8 or V80 variometer. HAWK compatibility depends on specific device configuration and can be checked in the About dialogue on the navigational device (**application version 8.03i or newer**)." Below this text is another paragraph: "Fill the form below to receive HAWK demo option activation instructions. After submitting the form, you will receive an email containing the instructions for activation of the HAWK demo. The processing of your request is done automatically and can take a few minutes. The demo is valid for 3 months and it starts counting from the date of installation." The form consists of three input fields: "Device Type \*" with a gear icon, "Device Serial Number \*" with a document icon, and "Email \*" with an envelope icon. At the bottom right of the form is a blue "Submit" button. In the bottom right corner of the browser window, there is a small icon for "Privacy - Terms".

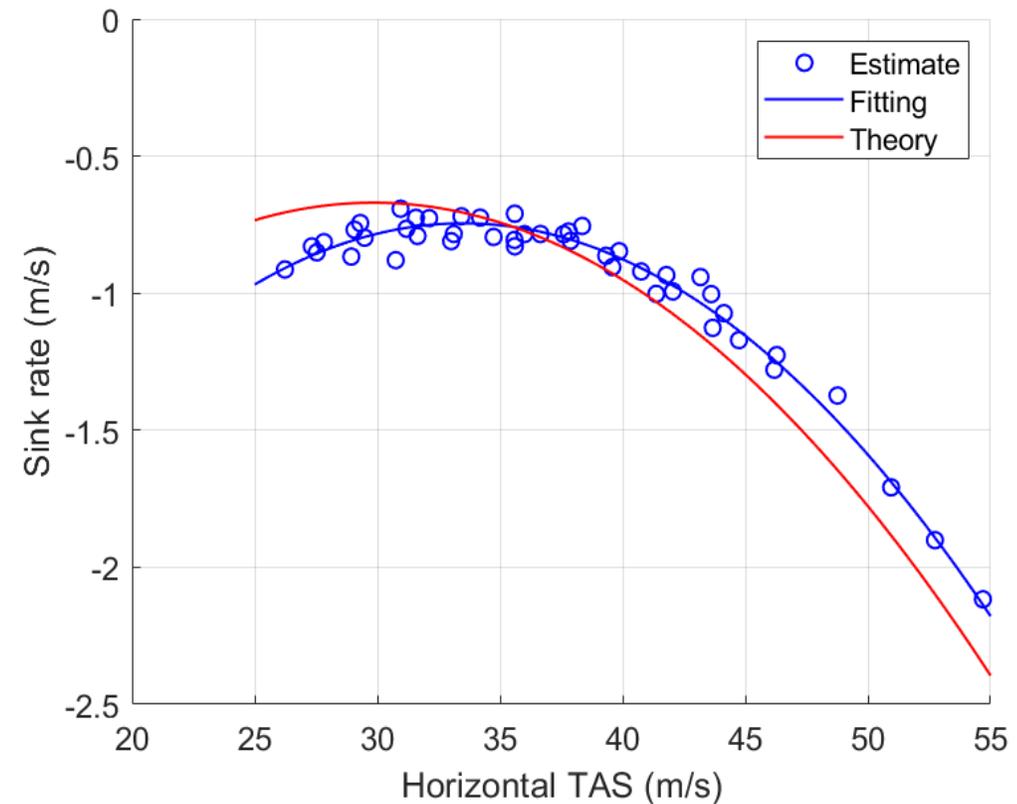
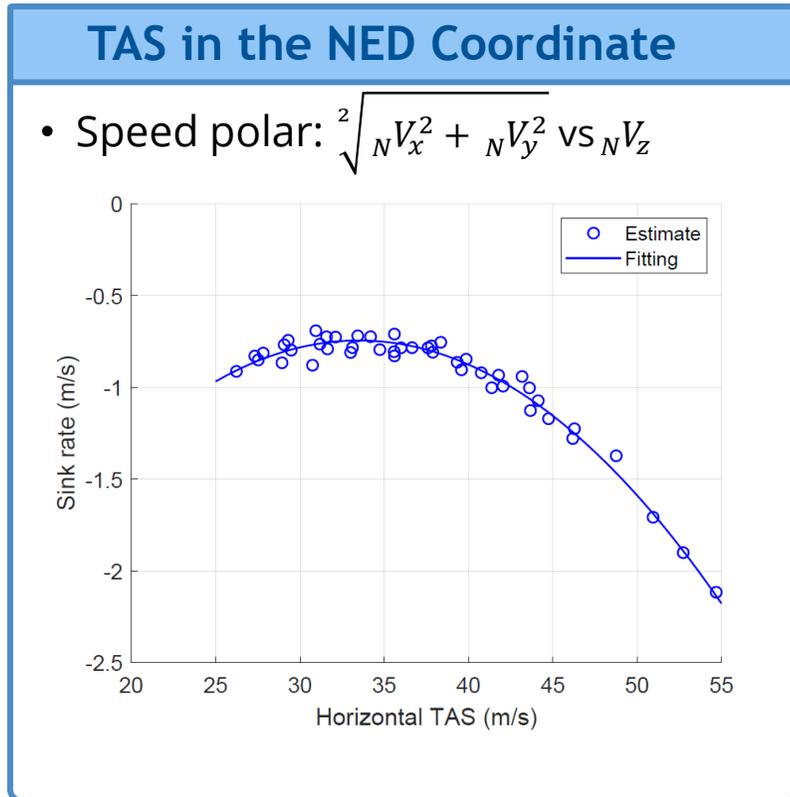
Part 4

# Future



# Glider performance estimation

## Speed polar



# Looking forward

Is momentary horizontal and vertical wind really something we are looking for?



# References

Peng Huang, Heinrich Meyr, *HAWK: Vario and instantaneous wind measurement using sensor fusion and digital signal processing*, XXXVI OSTIV Congress, 2024 , [Download PDF](#)

Peng Huang, Heinrich Meyr, *Experimental determination of the speed and lift polar using the multisensor HAWK platform*, XXXVI OSTIV Congress, 2024 , [Download PDF](#)

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