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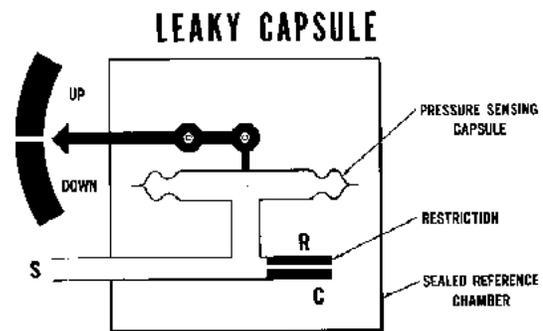Winter, Sage, Bohli (**flow variometers**)

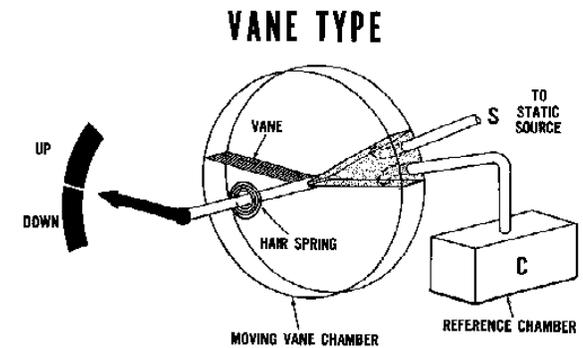
LEAKY CAPSULE

UP
DOWN

PRESSURE SENSING CAPSULE

RESTRICTION

R

S

C

SEALED REFERENCE CHAMBER

Figure 2

VANE TYPE

TO STATIC SOURCE

UP
DOWN

VANE

S

HAIR SPRING

C

MOVING VANE CHAMBER

REFERENCE CHAMBER

Figure 3

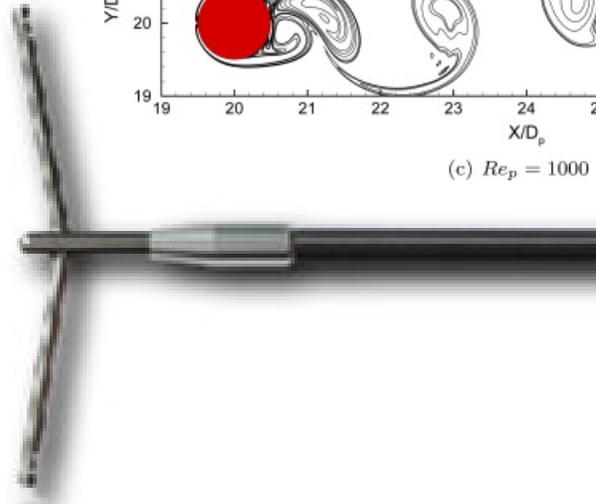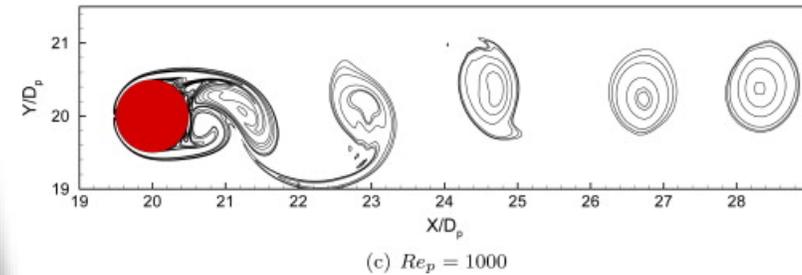# TE compensation

Total energy=kinetic energy + potencial energy
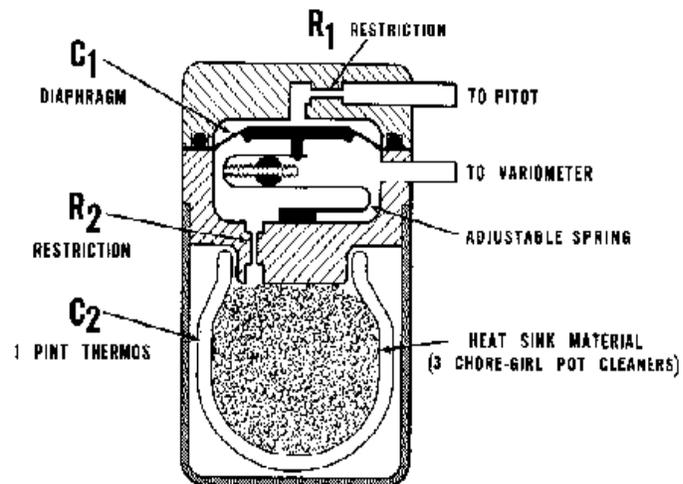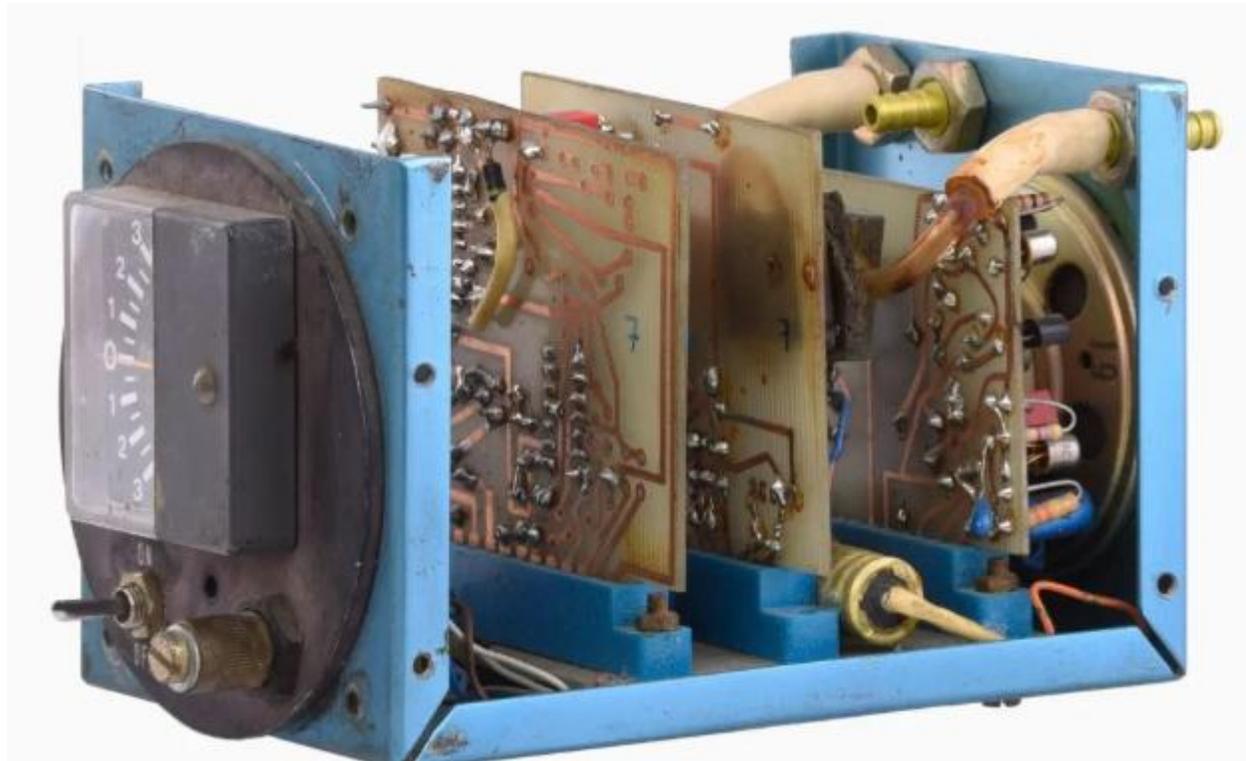

Capilar

TE tube

Electricity

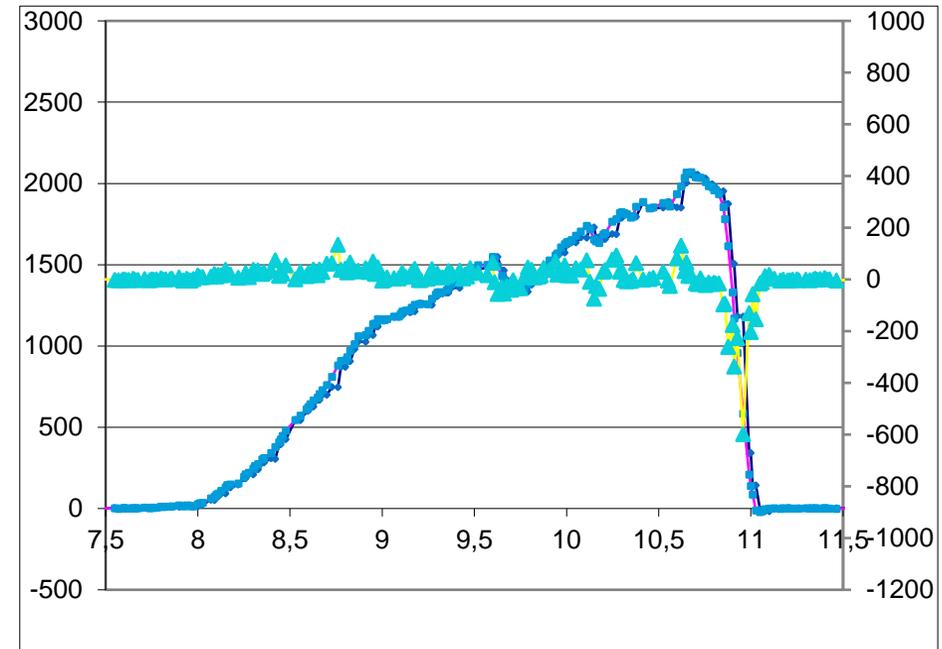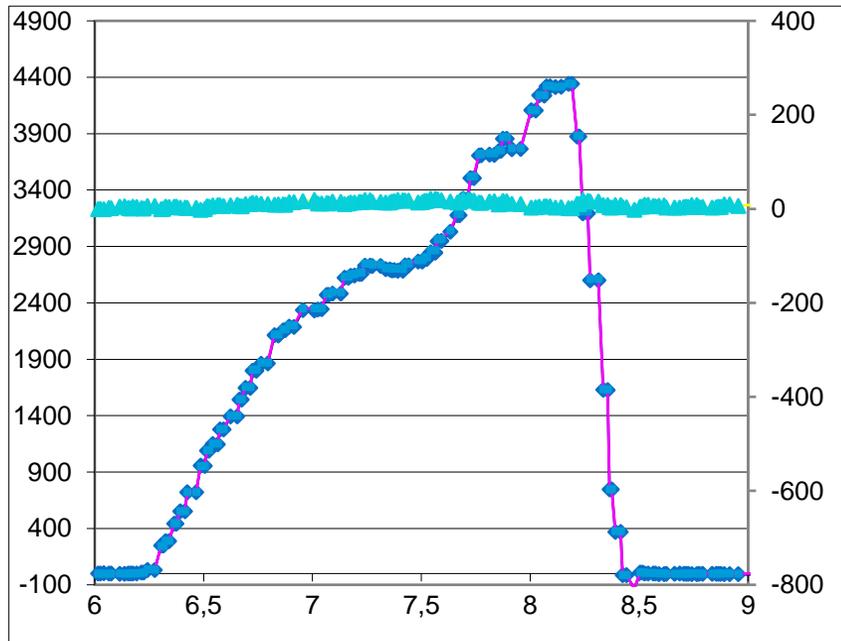Črt Rojnik, EV-82, LX500, LX1000 (**flow variometer**)

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

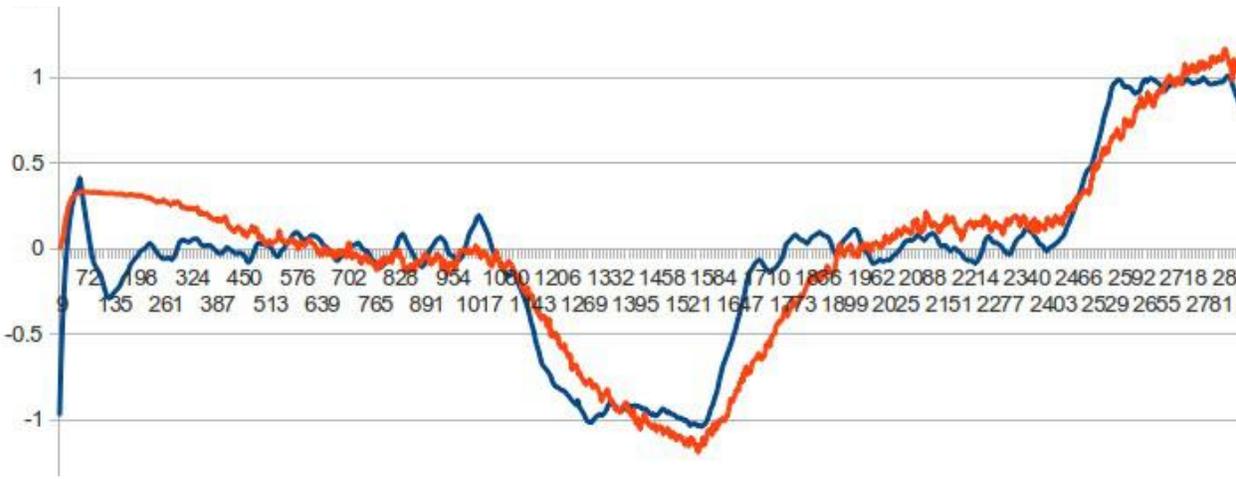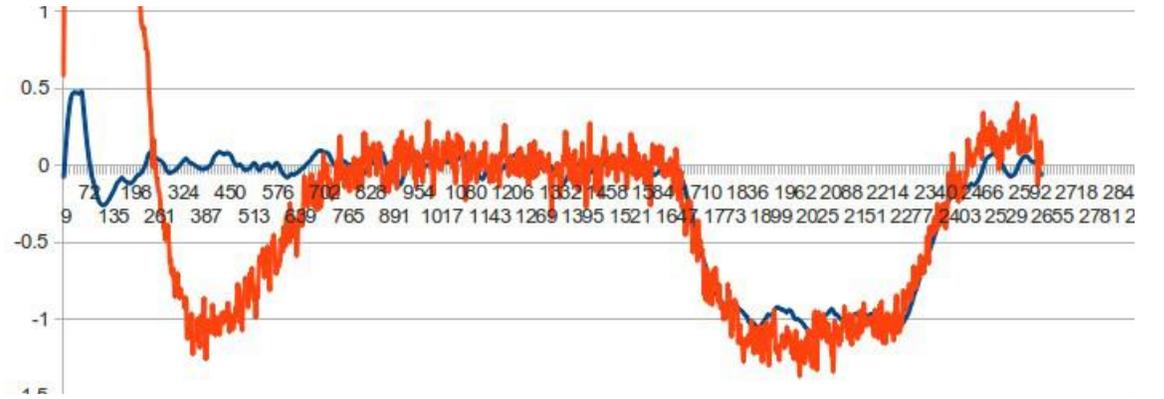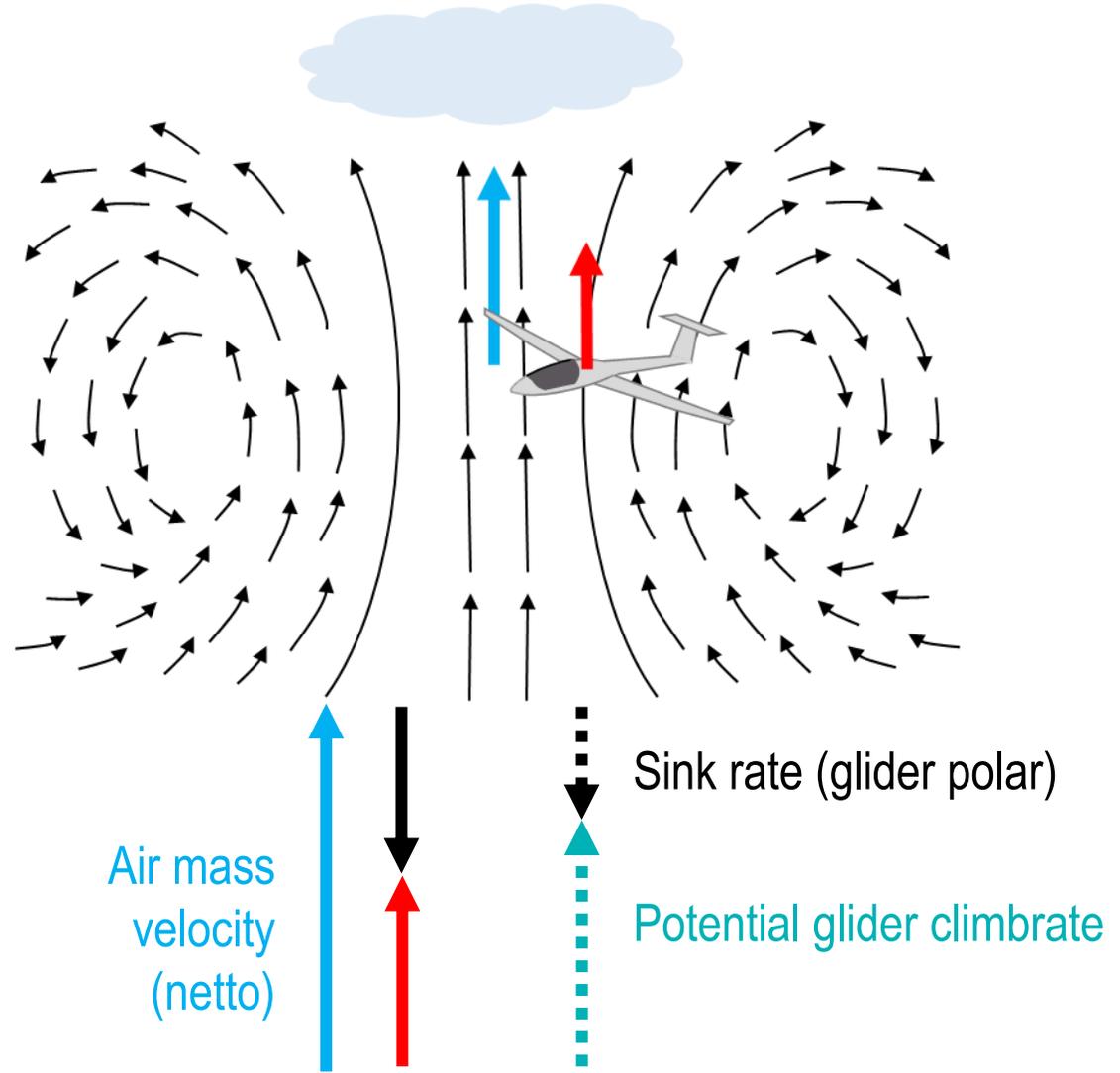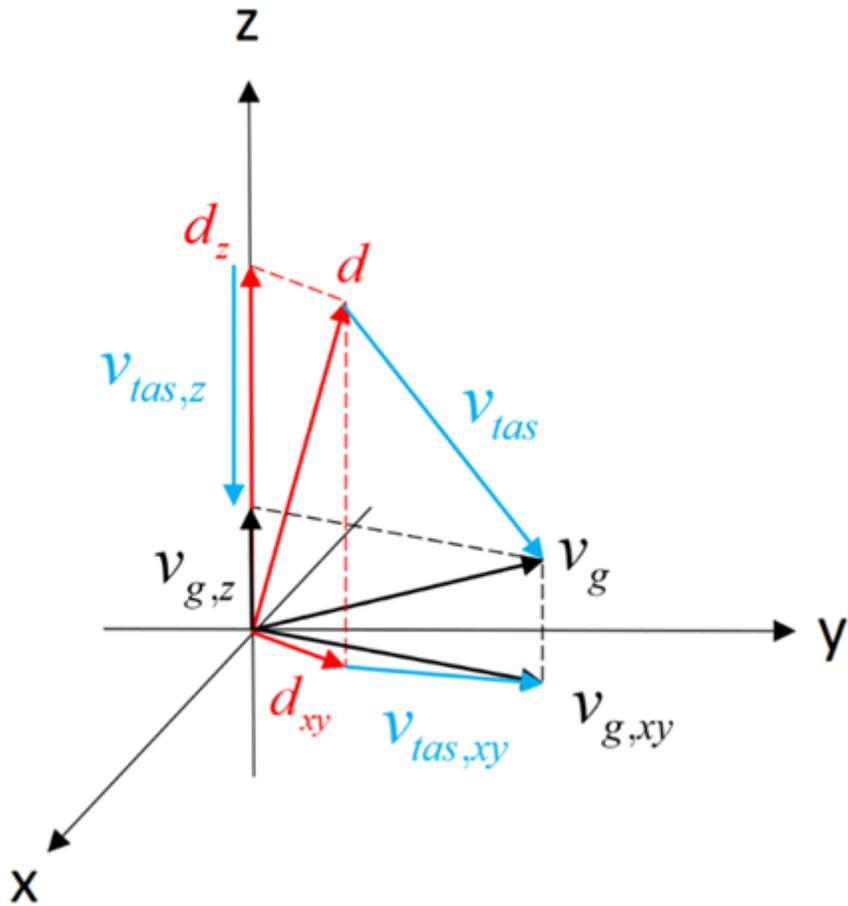$$w=w_0+a(t_2-t_1)$$

Part 2

HAWK development

Elevator

Complexity

d_z

d

$v_{tas,z}$

v_{tas}

$v_{g,z}$

v_g

d_{xy}

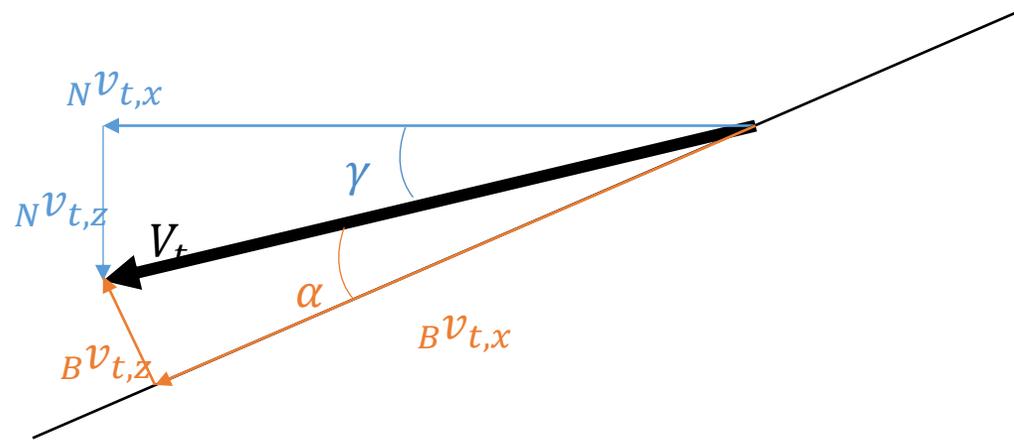$v_{tas,xy}$

$v_{g,xy}$

Air mass velocity (netto)

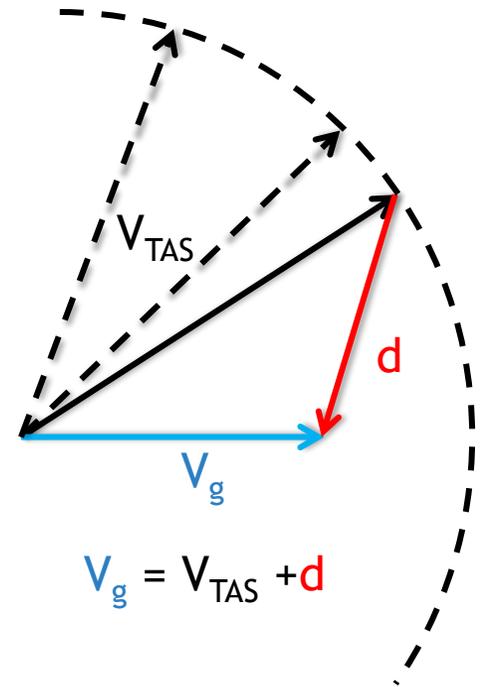Sink rate (glider polar)

Potential glider climbrate
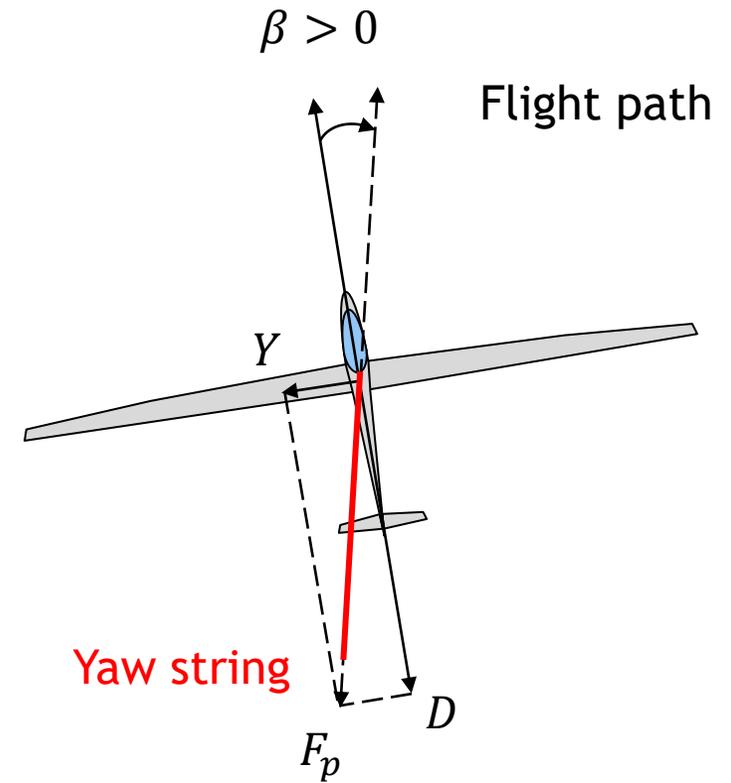
Complexity II

Complexity III

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

$$V_g = V_{TAS} + d$$

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.
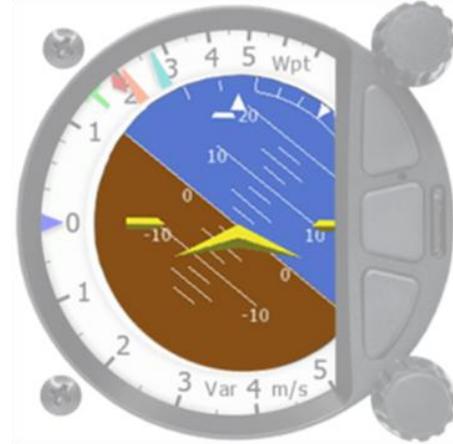   "Relative vario" equal "netto" - min sink rate

Development
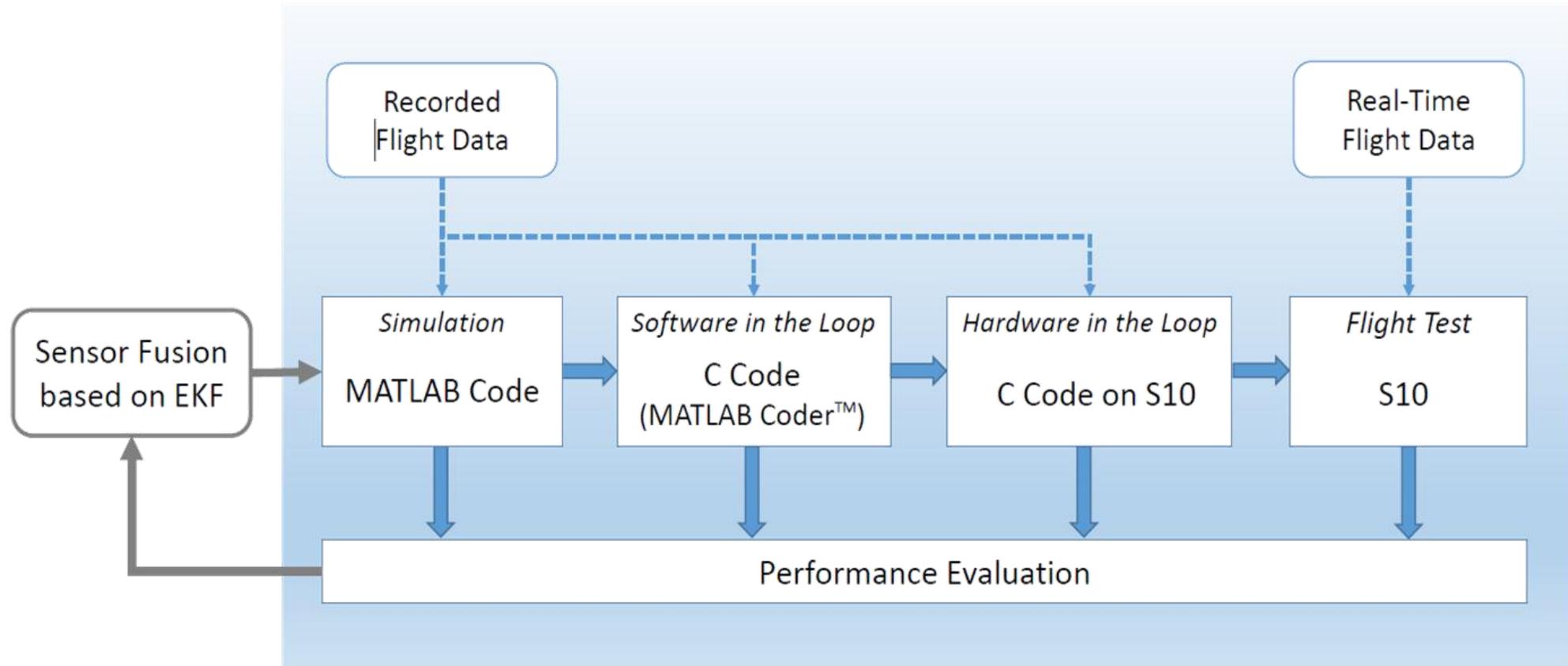
Result

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

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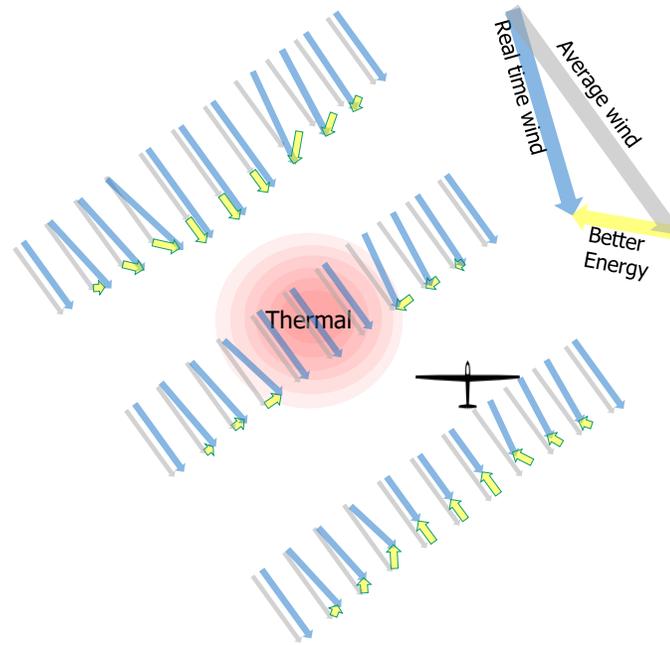- Detects thermals reliably with early warning
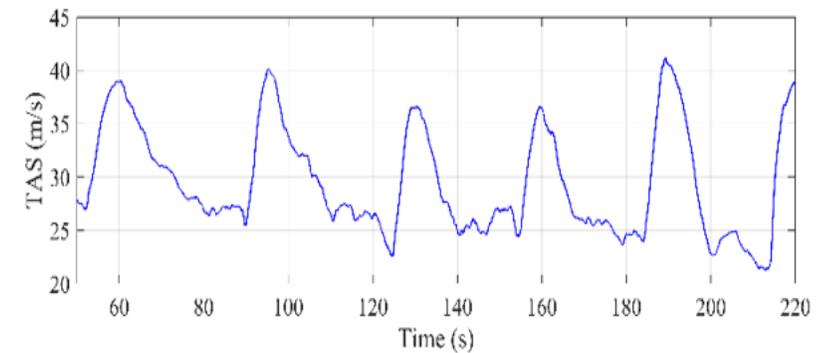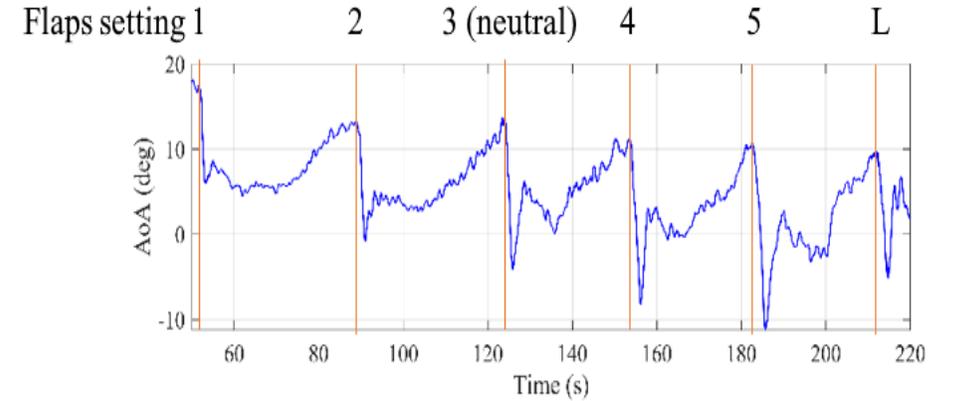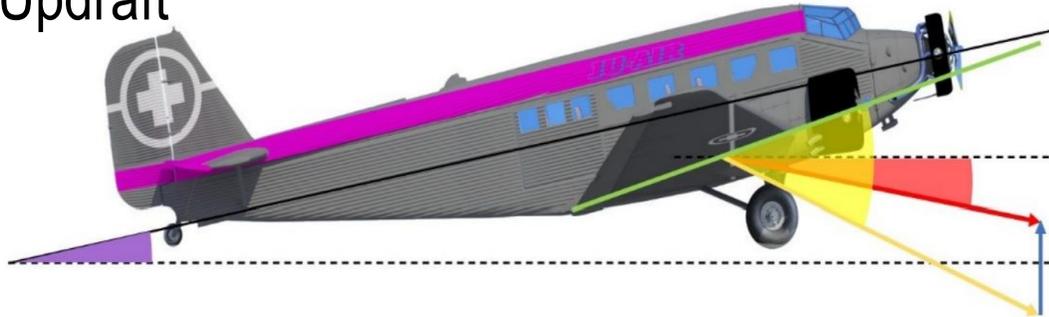- Horizontal wind is in real time

Part 3

HAWK usage

Indication

Angle of attack - AOA

Downdraft

Updraft

Flaps setting 1   2   3 (neutral)   4   5   L
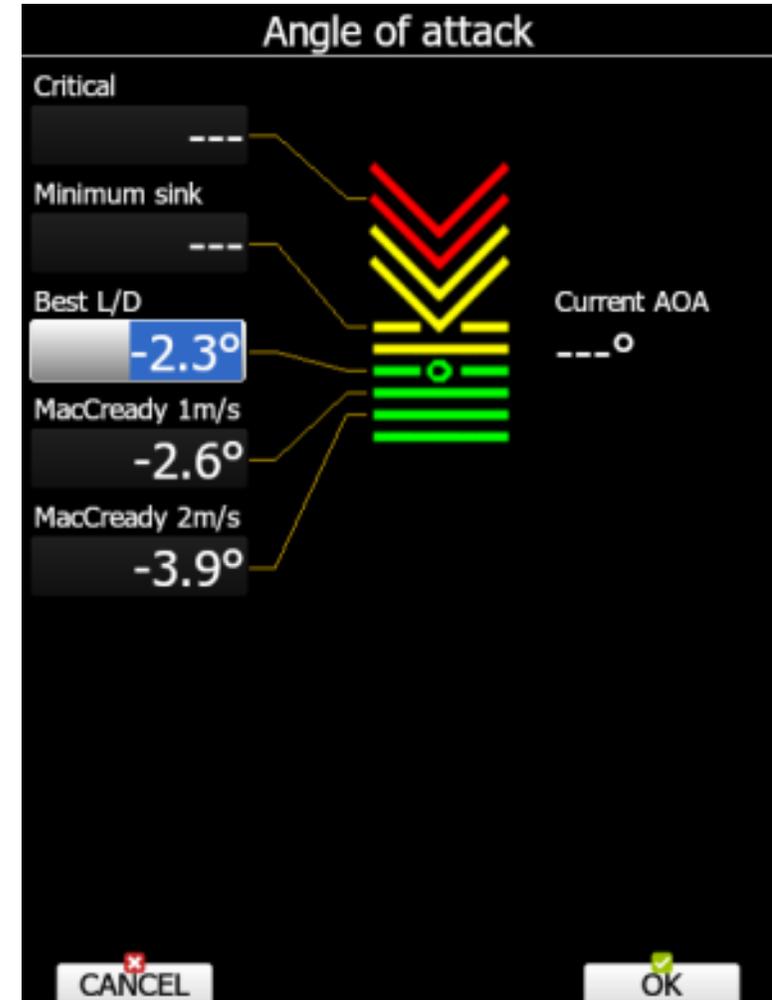
Swiss Transportation Safety Investigation Board STSB, SUST report 2370

Angle of Attack II

Setup

Wind variance
Horizontal wind average
Vertical wind average

Wind variance

Setup - Indicator

Two needles

Nonlinear dial style

SC needle, recommended netto

Setup - Audio

Audio source
SC mixed
Vario audio mode
Switching between Vario/SC mode
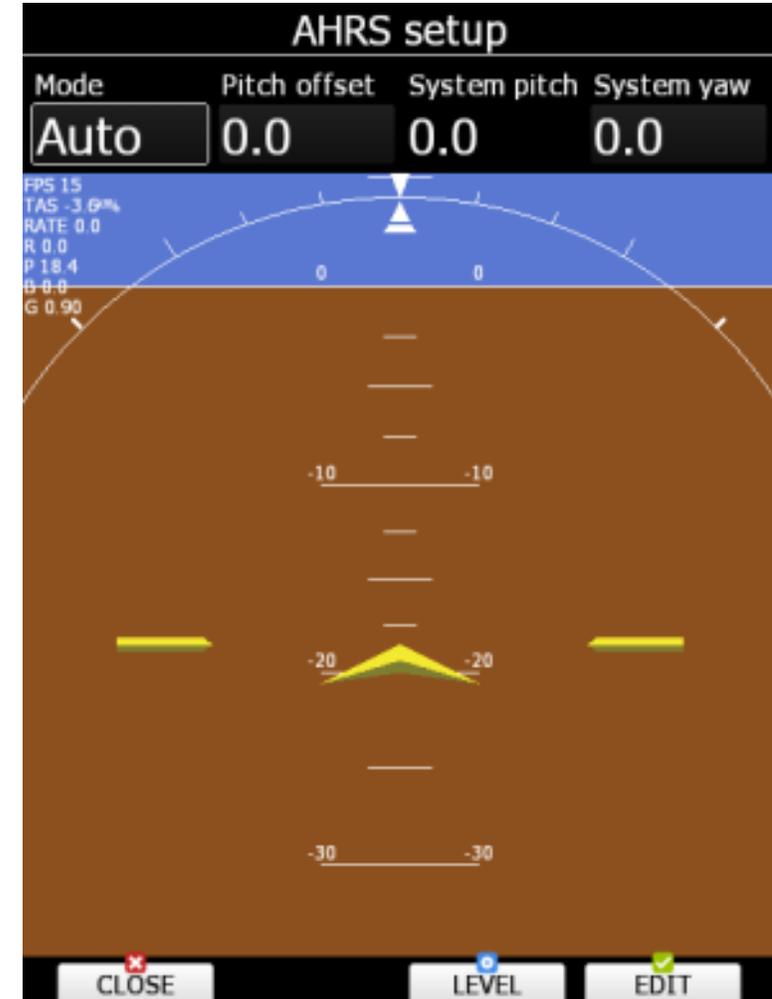
Installation

Levelling is crucial for proper operation of HAWK

Passwords:

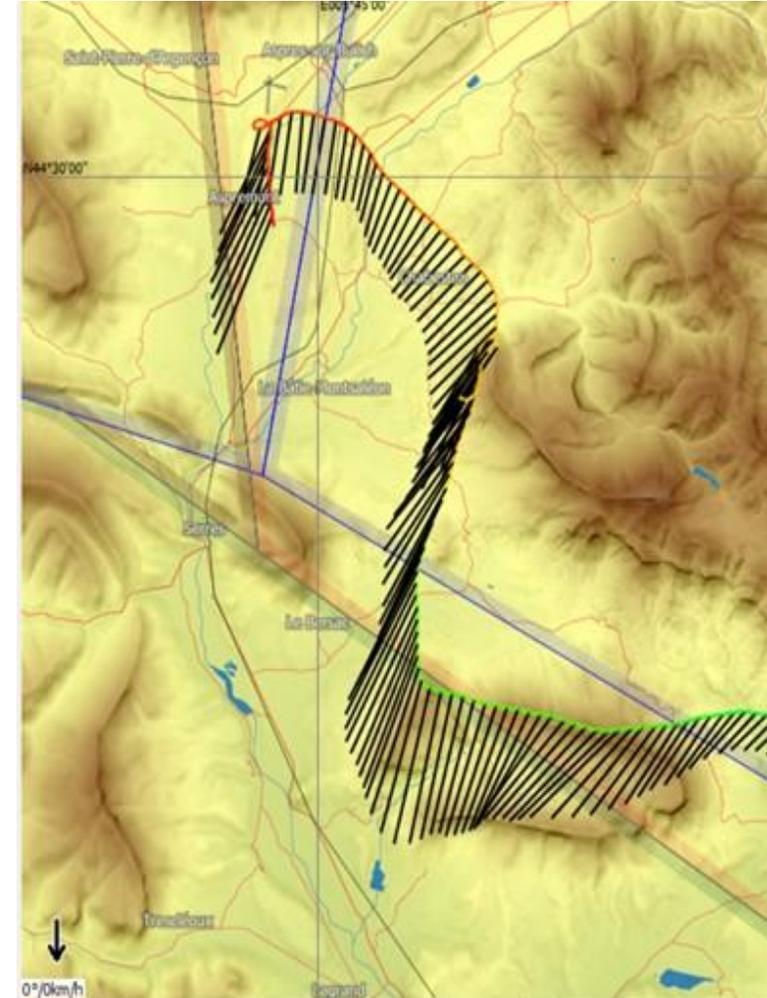1043 – airspeed offset

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/

Part 4

Future

Glider performance estimation

Speed polar

TAS in the NED Coordinate

- Speed polar: $\sqrt[2]{{}_N V_x^2 + {}_N V_y^2}$ vs ${}_N V_z$
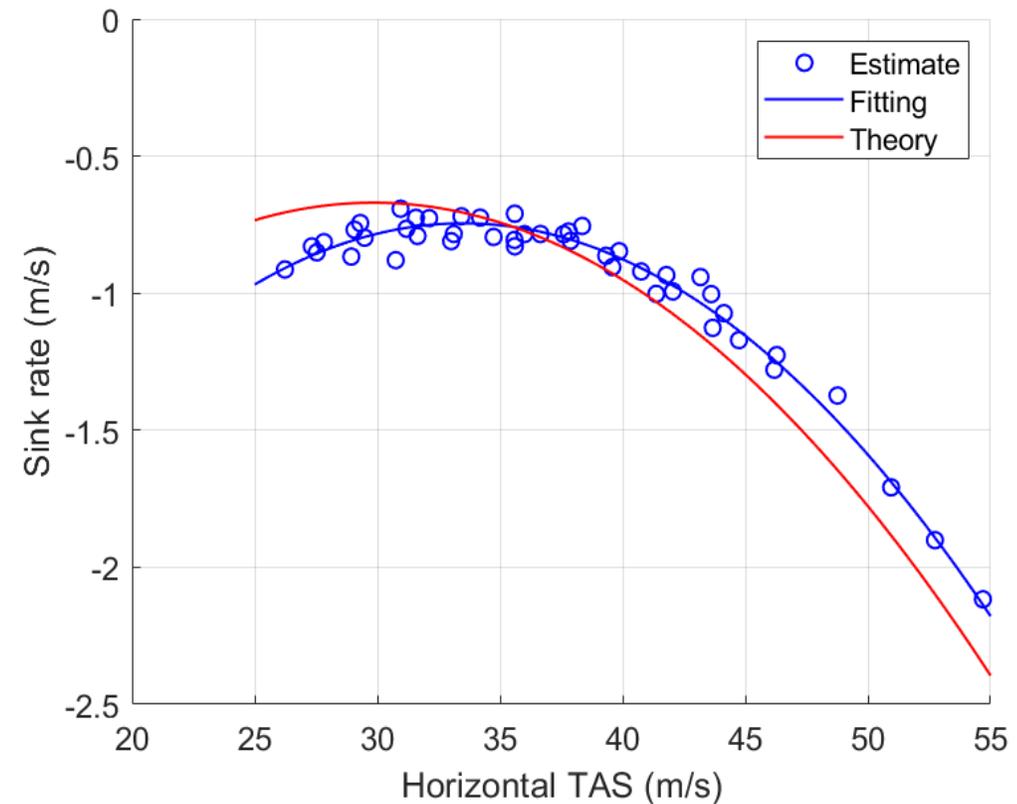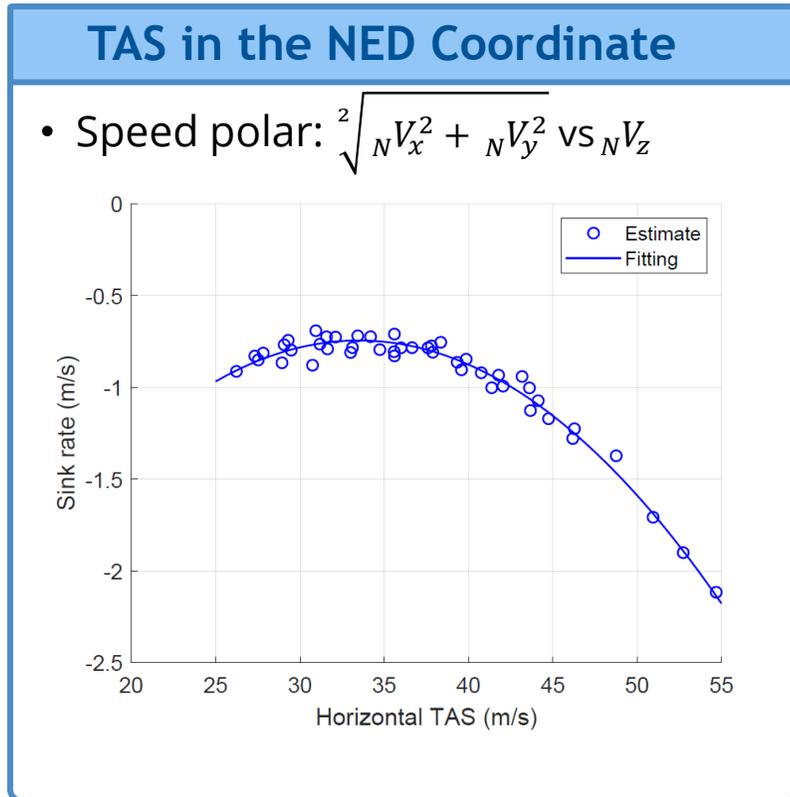
Looking forward

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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