



**Advanced training**

**Dynamic balancing of autogyro rotors**

Using Smartavionics PB4 dynamic balancer

**Program :**

**Day 1:**

- Various frequencies: vibration spectrum
- '1/rev vibration'/physics of rotor: tracking and imbalance, (C of G & centrifugal force, blade AOA)
- The dynamic balancer
- The Polar Chart
  - RTB process (Rotor Track & Balance)
    - o Various flavours (history)
    - o Adjustments
    - o Repeatability, calibration: move lines
- PB4 setup for RTB (Rotor Track & Balance)
- Accelerometers and tacho fitment on a gyro
- In flight measurement
- Data analysis (diagnostics)
- Span, chord & pitch calibration
  - o Significant adjustments
  - o In flight measurements
  - o Move lines creations
- RTB (Rotor Track & Balance) operations
  - o Rationally induced adjustments
  - o In flight measurements
  - o Further adjustments, according to progress
- Manufacturers' templates (discussion)

**Day 2:**

- Morning
- RTB simulation
- Setup, diagnostic and RTB operations on another gyro (repeat full RTB process with autonomy)
- Use of a second sensor (discussion)
- Afternoon
- Frequency Spectrum analysis (dominant sources of gyro vibrations : 2/rev, engine, propeller, blade,...)
- 2/rev vibrations :
  - o Causes
  - o Research
- Propeller balancing (if time available)

**Teacher:** Jérôme Prompsy or Mike Goodrich

**Public:** technicians in charge of design or maintenance of autogyros

**Required competencies:** technical conceptualization capability, familiar with computer software, English language proficiency

**Objective:** to be able to

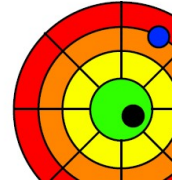
- diagnose vibrations
- balance and track

for a 2 blade autogyros rotor using a dynamic balancer

**Number of attendants:** from 1 to 6 max

**Teaching method:** 40% classroom course 60% practical workshops : PB4 operations on gyrocopter with measurement flights (weather permitting).

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**Site:** classroom, hangar, runway at an airfield

**Duration:** 2 days (2 x 7 hours)

**Language:** English (or French)

**Necessary conditions:** flyable weather with limited turbulences, operational runway allowing numerous short flights. At least one operational autogyro (supplied by customer), with an available pilot for the test flights (supplied by customer). A closed room with AC power, and video projector (with hdmi plug) for computer presentations (PPT)

**Note:** all mechanical works (e.g. torque) are carried out by or under authority of gyro owner (or representative) (his responsibility)

**Training documentation :** PDF

**Price:** 500 € per trainee (min 4 trainees) + travel & accommodation



### Basic Training : the keys for decision making

## The main causes of Autogyro vibration

Understanding the main causes of autogyro vibrations and the dynamic balancing.

#### Program:

- Elementary explanations: imbalance and using a dynamic balancer
- Reading the "Polar Chart" and qualifying levels of acceptable vibrations
- Reading the "Frequency spectrum" and identifying significant frequencies
- Rotor adjustments possibilities
- The current state of the art for autogyro vibrations

**Teacher:** Jérôme Prompsy

**Public :** Owners and autogyros (& helicopters) pilots.

**Objective:** understand the different vibration sources to allow owner/pilots to decide and supervise the balancing of their rotorcraft.

**Number of participants :** 5 minimum, no max

**Teaching method:** PowerPoint presentation

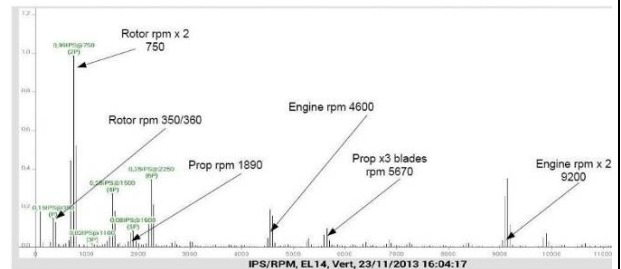
**Training materials:** document (4 pages)

**Site:** classroom

**Date:** to be decided

**Duration:** 1 hour

**Tarif :** 50 € per trainee + travel expenses



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We do not represent or sell any make of autogyro or equipment

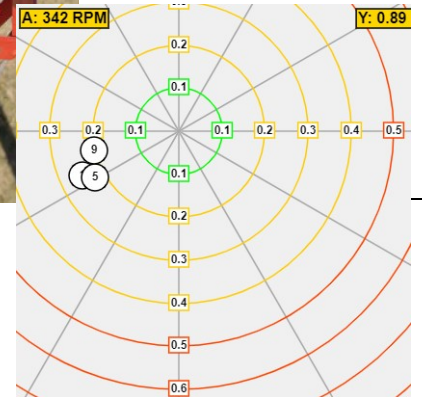
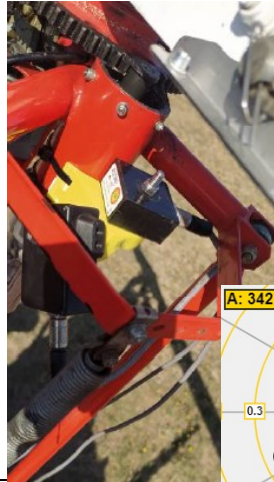


## Autogyro Vibrations Diagnostic

Measurement and analysis of the vibration condition of an autogyro using the Smart Avionics PB4 dynamic balancer. Installation of PB4 accelerometers and tachometer on customer's autogyro.

Printout of a vibration diagnostic **report** for this autogyro, including :

- 1/rev (~350 RPM) vibration characteristics (polar chart)
- Frequency spectrum (vibration levels at different frequencies), allowing identification of all vibration sources (prop, carb balance, etc)
- Possible recommendations of follow up actions in case some vibrations are outside acceptable levels



### Note :

- The customer is in charge of a short flight (usually an extended circuit) to record the vibration data.
- The vibration diagnostic report may be valuable for sale of the autogyro.

**Price:** 100€ per autogyro + travel expenses.

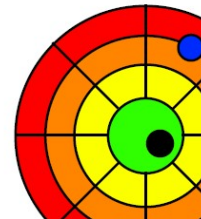
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### Rotor track and balance (RTB)

using a dynamic balancer (Smartavionics PB4) by adjustments to the rotor blade weight, chordwise shift and blades pitch to reduce the synchronous (1/rev) vibration to an acceptable level.



**Notes :**

- RTB realized according to manufacturer's procedure, when available.
- Some adjustments may need specific tools and/or parts (shims,...)
- The number of autogyros that can be balanced in one session is limited
  - o difficult to balance more than 2 or 3 gyros in one day.



**Engineer:** Jérôme Prompsy

**Public:** gyro owners and experienced pilots

**Number of gyros :** minimum 1, if possible several (RTB "club day")

**Site:** airfield

**Date :** to be decided

**Duration:** 1 day (8 hours),  
may be extended depending on gyros number and conditions

**Necessary conditions:** flyable weather with limited turbulence, operational runway, operational autogyro, fuel, experienced pilot, allowing short flights.

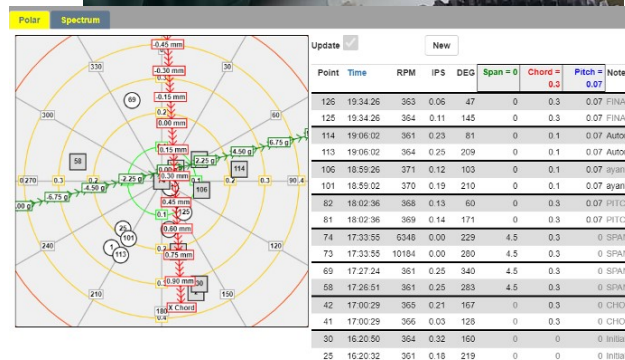
**Notes :**

- o the owner (or his pilot) carries out all flights (up to 10 extended circuits)
- o all mechanical works (e.g. torque) are carried out by or under authority of gyro owner (or representative) (his responsibility)

**Price :**

**240 €** per rotor + travel fees

(or 80€ per work hour if the intervention is limited (<2H) or includes work outside balancing scope (eg prop balance, carb balance, silent blocks change....)



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## Remote support (internet/telephone) for PB3/4 users

For experienced PB3/4 users who face interrogations or difficulties

Or for non-trained users in remote locations

**Consultant:** Jérôme Prompsy or Mike Goodrich

**Public :** technician balancing a rotor with the PB3/4, who has mechanical and computing experience/skills.

**Site :** Internet (email, Video conference, phone)

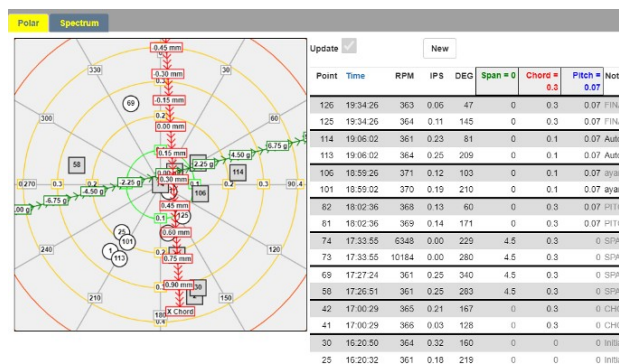
**Delivery/Availability :** Case by case. (discussions to be agreed depending upon availability)

**Method :** The technician (customer) in charge of the balancing installs the equipment on the gyro and performs the PB3/4 setup, data gathering flights and transmits the files by email.

**Tarif : 100 €** per hour. Each started hour is billable. Vayavolo sends regular report of time consumed

**For experienced PB3/4 technicians**, this support is usually to clarify some setup or procedure, **1 hour per rotor** is usually sufficient.

**For an PB3/4 novice**, the remote support can include a complete training session or just help on specific details. Our experience suggests that **3 to 5 hours of remote support for a gyro** should be sufficient depending upon the initial competence of the technician.



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## Remote Gyro Rotor Vibration Diagnostic

### PB4 supplied

for experienced technicians  
distant from Toulouse

**Remote engineer:** Jérôme Prompsy

**On site operator:** customer

must be

- gyro pilot
- familiar with computer software
- mechanically skilled
- English (or French) speaking

**Location:** distant collaboration

**Date:** to be agreed upon

**Duration:** one day

**Working stages:**

Vayavolo supplies a Smartavionics PB4 dynamic balancer, sent via DHL (or equivalent).

The on-site operator (customer) proceeds to sensors installation, PB4 setup, and measure flight, **with distant instructions** from Vayavolo.

Communication is through phone, visio-chat and e-mail

The PB4 is to send back a week later

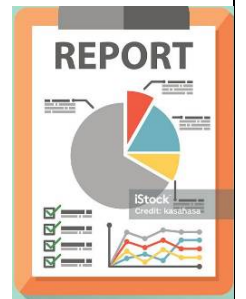
**Price: 330 €** (continental France)

(abroad : price depends on carrier fees)

**Deposit:** 2 000 € (not cashed in, returned once PB4 received back)

Distant instructions concern : balancer installation and setup, measurement procedure (but not basic mechanics or software). Vayavolo proceeds to measurements data analysis. **1 hour** distant support is included.

The 'gyro rotor vibration diagnostic' **report** is **supplied** some days later



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## Remote RTB (Rotor Track & Balance)

### PB4 supplied

for experienced technicians  
distant from Toulouse

**Remote engineer:** Jérôme Prompsy

**On site operator:** customer

must be

- o gyro pilot
- o familiar with computer software
- o mechanically skilled
- o English (or French) speaking

**Location:** distant collaboration

**Date:** to be agreed upon

**Duration:** one day

**Working stages:**

This distant service, follows the 'Remote Gyro Rotor Vibration Diagnostic': it cannot be realized independently, without prior diagnostic.

The on-site operator (customer) proceeds to calibration flights and adjustments **with distant instructions** from Vayavolo.

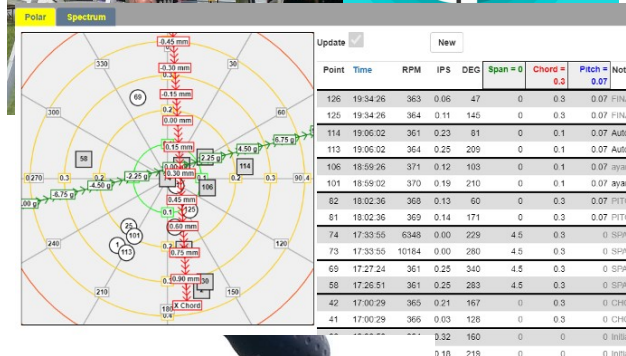
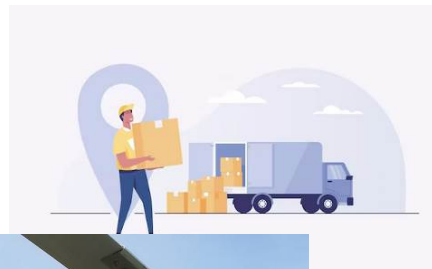
Communication is through phone, visio-chat and e-mail

The PB4 is to send back a week later

**Price: 240 €**

Distant instructions concern : RTB procedure, rotor calibration, adjustments, PB4 software manipulation (but not basic mechanics or software). Vayavolo proceeds to data interpretation. **2 hours** distant support are included

The 'gyro RTB' **report** is **supplied** some days later



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## PB4 rental

For PB4 experienced technicians  
distant from Toulouse

**Duration:** 1 week

**Terms and conditions :**

Vayavolo supplies a Smartavionics PB4 dynamic balancer, sent via DHL (or equivalent)

**Price: 200 €** (continental France)  
(abroad : price depends on carrier fees)

**Deposit:** 2 000 € (not cashed in, returned once PB4 received back)

