

A gentle introduction to the **ARDUPILOT** ecosystem

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Saturday, 3rd of June 2017

UAVs for hobbyists

What was possible before vs now

Before

RC models, lots of crashes



Now:

Many stabilization systems



+Commercial autopilot products

Commercial systems, boards and features



DJI A3 autopilot

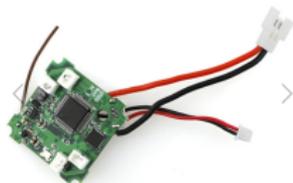
Tarot ZYX-M Flight Controller



Multicopter Tarot autopilot



Horizon Hobby SAFE system



No-name multicopter autopilot

Open-source projects

The maker's alternative



Paparazzi



PX4



Ardupilot

Ardupilot - Summary

- It is an ecosystem around unmanned systems
- Core international team of programmers and engineers + hundreds of smaller commits
- Has been around since 2009
- Open-source/hardware profile (Public repo, team coordination calls, mailing list, gitter, hosted GSOC this summer)

Supported platforms



Plane



Copter (multi or traditional)



Rover



Submarine (recently)



Antenna Tracker

A typical airplane setup

	Component	Typical cost(euros)
1	Airframe	50-100
2	Servos	30
3	ESC and motor	30
4	Battery	25
5	Flight controller + peripherals	150-300
6	Radio control	150
	Total cost	535

Part 1 : Firmware

- Common libraries backend and platform-specific code
- Mostly written in C++ (Originally in Arduino-C)
- All up in Github

The screenshot shows the GitHub repository for ArduPilot. At the top, it displays the repository name 'ArduPilot / ardupilot' and statistics: 559 Unwatched, 2,540 Stars, and 5,306 Forks. Below this, there are navigation tabs for Code, Issues (857), Pull requests (119), Projects (5), Wiki, and Insights. A section titled 'ArduPlane, ArduCopter, ArduRover source' includes a link to 'http://ardupilot.org/'. Below this are several tags for different components: arducopter, ardupilot, arduplane, ardurover, arduub, uav, drone, plane, copler, rover, sub, autopilot, mavlink, dronekit, uas, ros, ugv, rov, robotics, and auv. At the bottom, a summary bar shows 27,513 commits, 22 branches, 156 releases, 308 contributors, and the GPL-3.0 license.

ArduPilot / ardupilot

Unwatch 559 ★ Unstar 2,540 🍴 Fork 5,306

<> Code ⓘ Issues 857 📄 Pull requests 119 📁 Projects 5 📖 Wiki Insights ▾

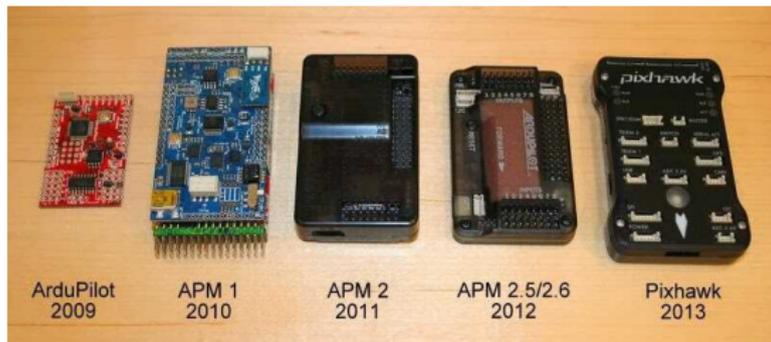
ArduPlane, ArduCopter, ArduRover source <http://ardupilot.org/>

arducopter ardupilot arduplane ardurover arduub uav drone plane copler rover sub autopilot mavlink dronekit

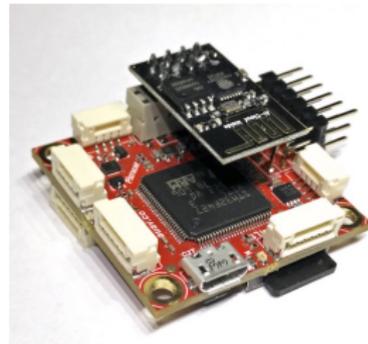
uas ros ugv rov robotics auv

📄 27,513 commits 🌿 22 branches 📦 156 releases 👤 308 contributors 📄 GPL-3.0

Part 2 : Boards



Early boards



Pixracer



Pixhawk 2.1



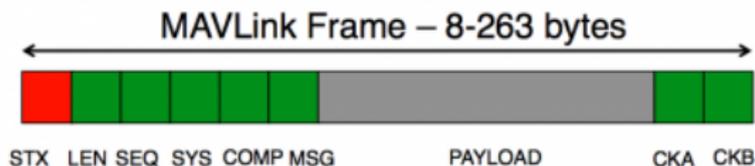
Chinese boards

Part 3 : Ground Control Software (GCSs)



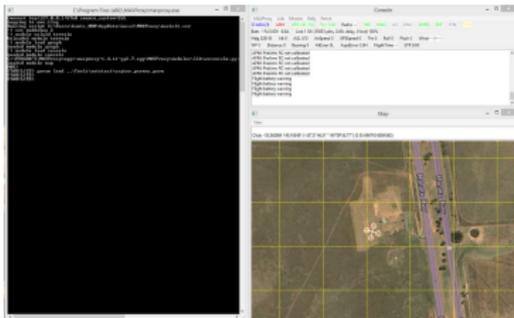
MICRO AIR VEHICLE COMMUNICATION PROTOCOL

The MAVLink UAV protocol



MAVLink packet anatomy

Part 3 : Ground Control Software (GCSs)



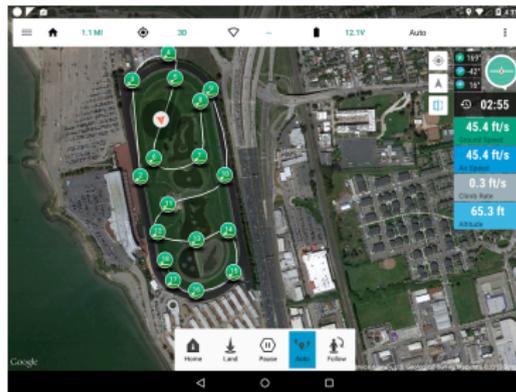
MAVProxy



Mission Planner



APM Planner 2



Tower

Typical Functionality

a.k.a Flight Modes

What is more than traditional gyros

- Stabilization
- Angle control
- Full state control
- Loiter
- Auto mission
 - Waypoints
 - Peripheral control
 - Takeoff
 - Landing
- Failsafes

⇒ Demo

First-time setup pains

Plenty of (long) tutorials in the wiki

- 1 Tuning through a parameter system
- 2 Calibrate Tx (Soon the servos as well)
- 3 Setup output channels
- 4 PID gains (or Autotune) for attitude control
- 5 Specify airspeed envelope
- 6 Setup TECS
- 7 Setup Navigation

Typical workflow

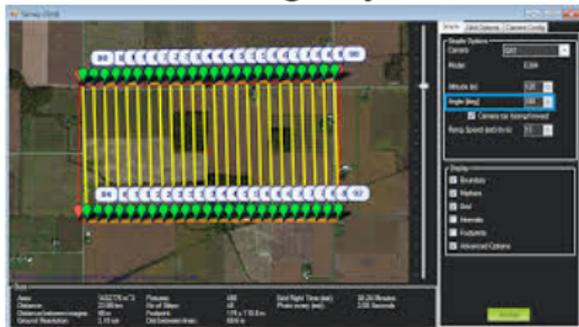
and a few use cases



Just go fly!



FPV ship



Aerophotography



Robotics (+ API!)

- Mission Planner scripts (Primitive Python API, <http://ardupilot.org/planner/docs/using-python-scripts-in-mission-planner.html>)
- mavros (aligned with PX4, <http://wiki.ros.org/mavros>)
- MAVProxy modules (Python, <http://ardupilot.github.io/MAVProxy/html/development/mavcustmod.html>)
- Dronekit (Python, Android, <http://python.dronekit.io/>) (Demo)

More info on:

- Github (<https://github.com/ArduPilot/ardupilot>)
- Forum (<https://github.com/ArduPilot/ardupilot>)
- Gitter channel (<https://gitter.im/ArduPilot/ardupilot>)
- Documentation/wiki (<http://ardupilot.org/ardupilot/>)
- diydrones.com

End of presentation

Thanks for listening!