

## **MICRO-502\_Aerial\_Robotics\_Notes**

### **Flapping-Wing (week9)**

### **Drone Regulations (week9)**

### **UAS Hardware (week10)**

Introduction

Frame and materials

materials comparison

metric when considering materials

Energy sources

Actuators for propulsion and maneuvering

Propellers

Sensors

Autopilots

Communication protocols

# **MICRO-502\_Aerial\_Robotics\_Notes**

*Lecture notes by Yujie He*

*Last updated on 2021/4/29*

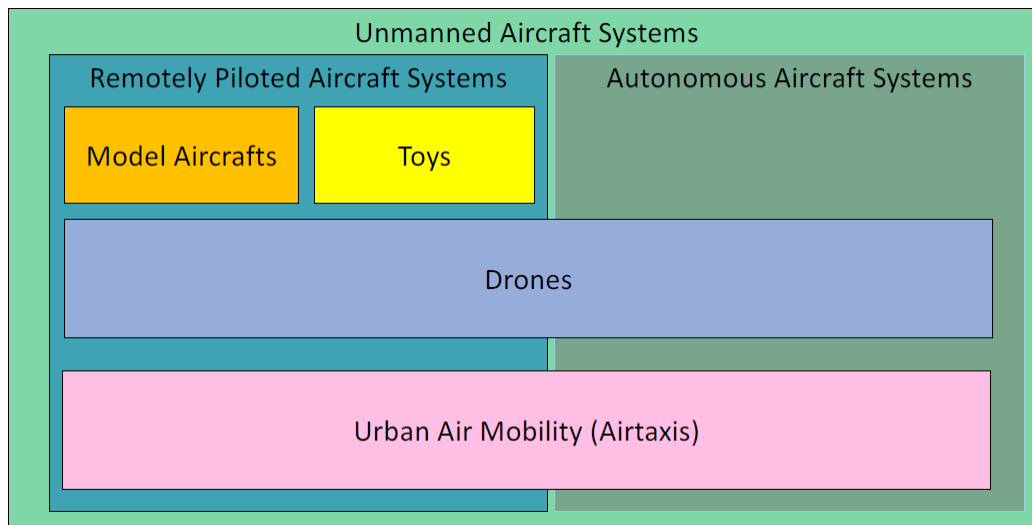
## **Flapping-Wing (week9)**

## **Drone Regulations (week9)**

*Author: Markus Farner*

<https://www.bazl.admin.ch/bazl/en/home/good-to-know/drohnen.html>

- Unmanned Aircraft Systems (UAS)  $\Rightarrow$  Drones; UAS = Remotely piloted aircraft systems / autonomous aircraft systems

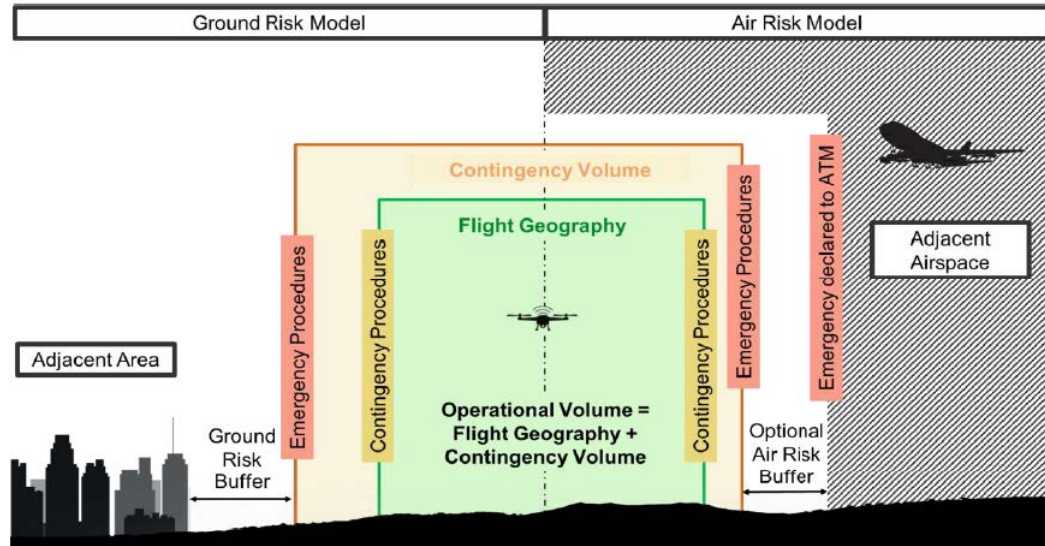


- Rules in Aviation: Federal Office of Civil Aviation Switzerland
- Everything which is not forbidden is allowed -> Switzerland  
Trust, less difficult for innovation
- 3 Pillar Concept / Drone Categories
  1. Open-Within the legal framework (No Authorization required)
  2. Specific-Not sufficiently safe (Authorization required)
  3. Certified-Approved to accepted standards
- Act
  - **Ordinance on Special Category Aircraft**
    - No authorization required for commercial flights
    - No distinction between Unmanned Aircraft and Model Aircraft
  - **DETEC Ordinance on Special Category Aircraft**
    - No authorization below **30kg**
    - Within direct visual contact (VLOS)
    - Not within a distance  $\leq 100\text{m}$  around crowds
  - **ANSP (Skyguide) or Airport responsibility**
    - **> 5km** Distance to civil & military airports/aerodromes
    - **< 150m** AGL (Above Ground Level) within a CTR
- Act in EU
  - Open/Specific/Certified
  - Difference
    - restrictions: MTOM **25kg**
    - maximum flying altitude: **120m**

- Specific Category

*Application for an operating permit on the basis of the **SORA (Specific Operations Risk Assessment)***

**Operational Volume = Flight Geography + Contingency Volume**



- ? Robustness Levels: Integrity + Assurance
- U-Space

*The U-space is a collection of decentralized services that collectively aim to safely and efficiently integrate drones into the airspace and enable drone operations alongside manned flight.*

<https://www.bazl.admin.ch/bazl/en/home/good-to-know/drohnen/wichtigsten-regeln/uspace.html.html>

<https://www.skyguide.ch/en/events-media-board/u-space-live-demonstration/>

airspace in block to avoid collision and report the location for further path calculation

## UAS Hardware (week10)

### Introduction

*main component required*

## 1. The aerial vehicle

- Air frame
- Actuators for propulsion and control
- Energy source
- Autopilot
  - Sensors for attitude estimation
  - Electronics for regulation, control and communication
  - Sensor and avoid system

## 2. Payload

- Cameras
- Environmental sensors (wind, temperature, humidity)
- Robotic arms for manipulation

## 3. Ground Control Station

- Communication systems
- Interface to monitor internal parameters and to send commands to the vehicle

# Frame and materials

## materials comparison

Material	Composite	ABS/PLA	Wood	Foam
Pros				
Cons				
Comment				

## metric when considering materials

- Young's modulus [[wiki](#)]  
弹性模量，正向应力与正向应变的比值
- Specific modulus [[wiki](#)]  
比模量，单位密度的弹性模量，劲度 - 质量比，在航天工业中有广泛应用。

# Energy sources

**Actuators for propulsion and maneuvering**

**Propellers**

**Sensors**

**Autopilots**

**Communication protocols**