



# **Airborne imaging for heritage documentation using the Fotokite tethered flying camera**

*Geert Verhoeven - Sergei Lupashin - Christian Briese - Michael Doneus*





Ludwig Boltzmann Institute  
Archaeological Prospection and Virtual Archaeology

Low-altitude imaging in archaeology

# INTRODUCTION



- Site detection & inventarisation



- Site documentation



- DSM creation





- ❑ Conventional AP might be forbidden
  - military regimes - flying restrictions
  
- ❑ Conventional AP might be inconvenient
  - weather conditions - topographic features
  - speed aircraft - spatial resolution
  - too expensive



- ❑ Lower/slower platforms
  - helicopters
  - balloons
  - powered parachutes
  - paramotors / ULMs

- ❑ Unmanned solutions

- balloons
- kites
- poles
- UASs

**LAAP**  
**Low-Altitude**  
**Aerial Photography**



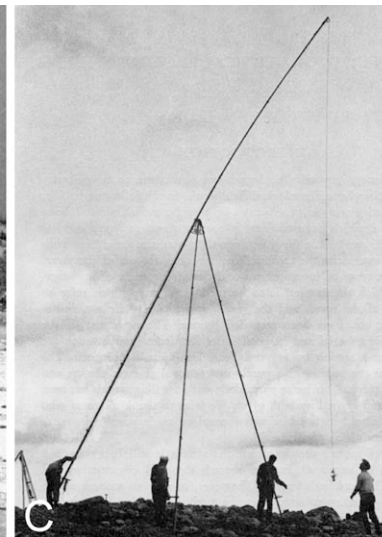
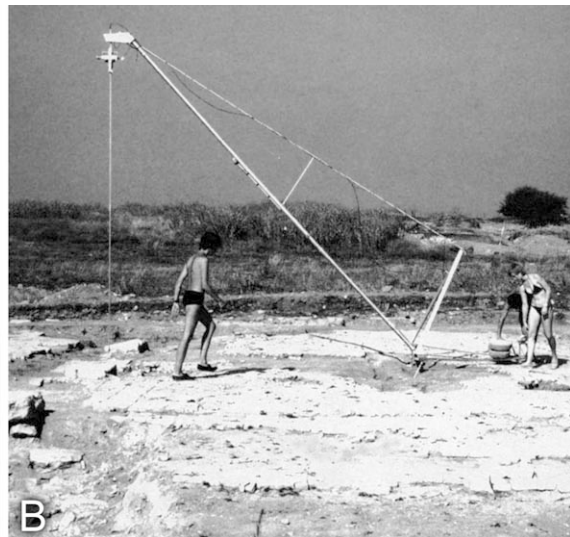
## □ Telescopic masts to large tripods

### □ Pros

- high temporal resolution
- high spatial resolution
- portable – affordable
- positioning camera

### □ Cons

- operation height
- casting shadows
- large area mapping





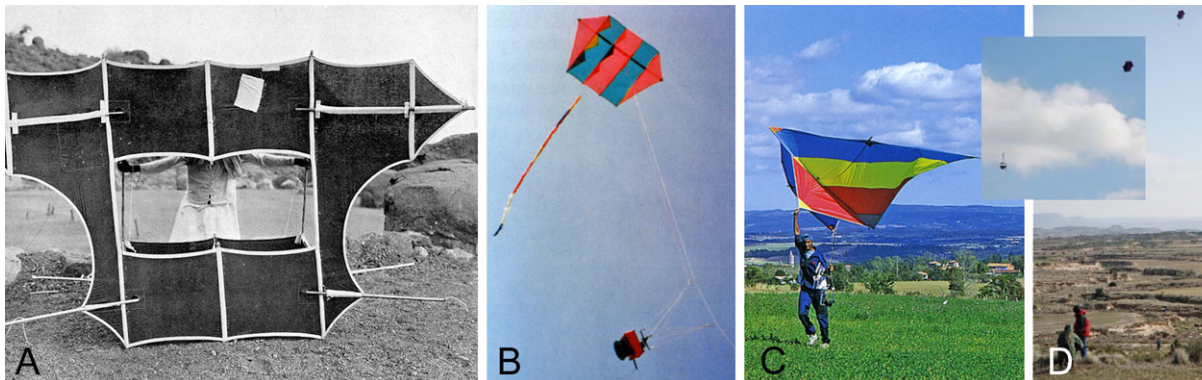
❑ Popular in 70`s and 80`s

❑ Pros

- wind specific kites
- highly portable
- affordable
- only manpower + wind needed
- payload

❑ Cons

- large area mapping
- payload
- steady wind needed
- positioning camera





# LAAP platforms – Balloons/blimps

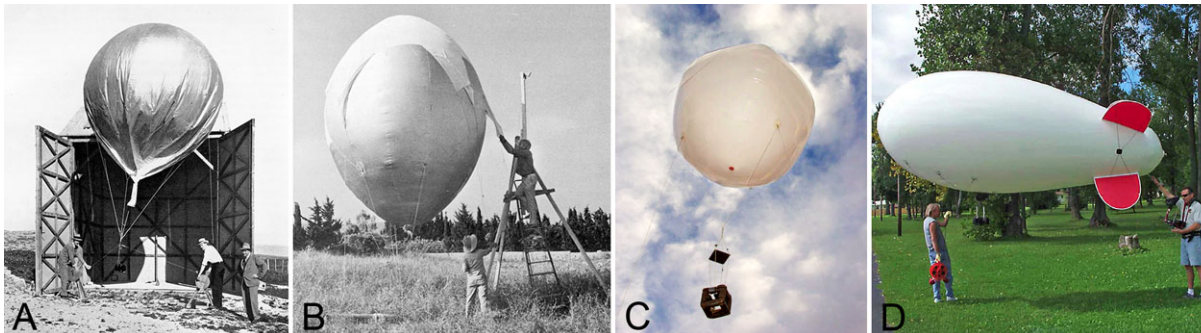
❑ Popular in 60`s and 70`s

❑ Pros

- several models
- aloft for days
- easy to operate
- vibration free

❑ Cons

- wind sensitivity
- cost helium
- photographing tether
- large area mapping
- positioning camera





# LAAP platforms – Helikites

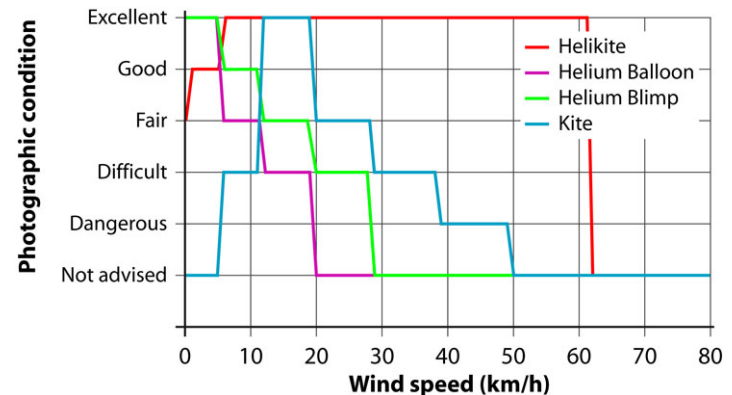
□ Hybrid patented in 1993

□ Pros

- pros kites & balloons
- payload
- easy to operate
- vibration free

□ Cons

- cost helium
- storing inflated
- large area mapping
- positioning camera







## □ UAS – Unmanned Aerial/Aircraft System

- uncrewed powered aerial vehicle
- ground and air segment



## □ Synonyms

- drone
- Unmanned Vehicle System (UVS)
- Remotely Piloted Vehicle (RPV)
- Remotely Operated Aircraft (ROA)
- Unmanned Aircraft/Aerial Vehicle (UAV)
- Remotely Piloted Aircraft System (RPAS)





UV types and applications

# UNMANNED AERIAL SYSTEM (UAS)



## □ Rotary wing

- higher payload
- accurate positioning
- slower
- no landing streep needed



## □ Fixed wing

- less vibrations
- fast
- larger areas
- wind resistance





## □ Pros

- situation-specific
- large area mapping
- less wind dependent
- autonomous
- positioning camera
- payload
- take-off /landing
- advanced functions

## □ Cons

- payload
- cost
- experience
- crashes - malfunction
- legislation
- vibrations
- take-off/landing strip
- batteries/petrol/gas
- size





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An alternative

**FOTOKITE**

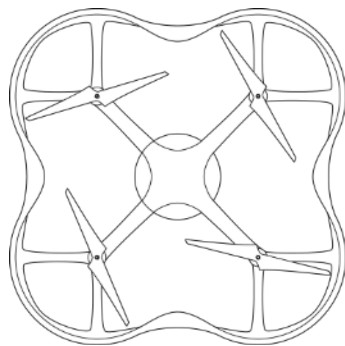




- ❑ Tethered flying camera
  - quadcopter + tether
  - solely IMUs
- ❑ Developed @ ETH Zürich
- ❑ <http://www.fotokite.com>

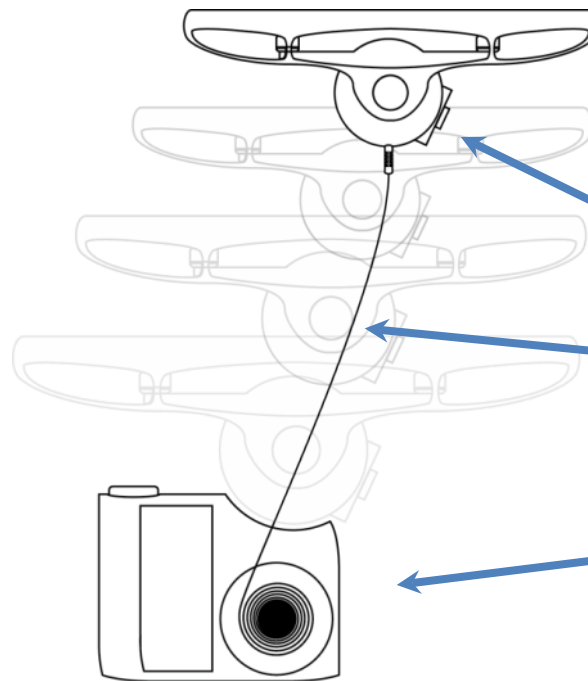


## □ Current technology development



40 cm

- Height: 9 cm
- Mass: 500 - 600 g



### Quadcopter flight unit

- Handles unsafe operating conditions
- Safely lands on error
- Canned maneuvers

- GoPro/camera dock

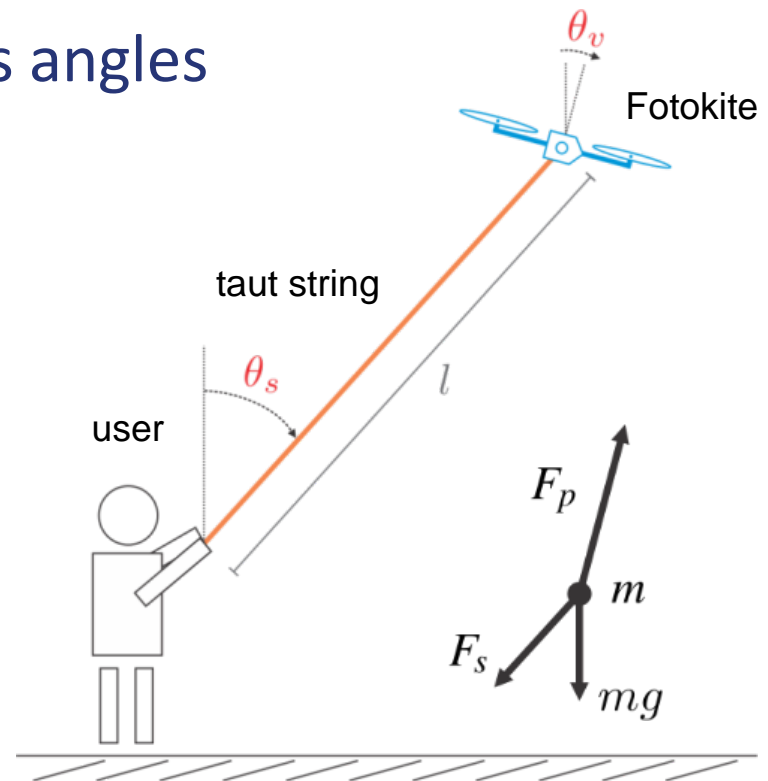
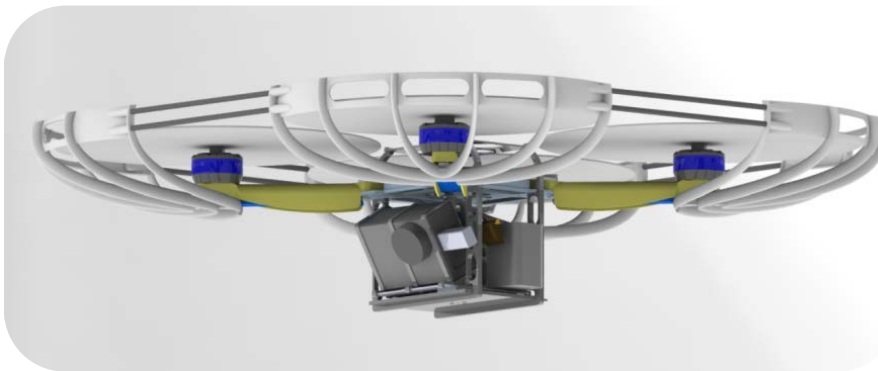
- 25-meter tether

### Motorized Handheld Unit:

- Gyros for gesture control
- Integrated smartphone dock



- ❑ No GNSS, mocap, vision, pilot
- ❑ System observed via inertial sensors
- ❑ Fotokite observes and controls angles
- ❑ Fundamentally user-centric







# Fotokite – Advantages

- ❑ No specific skills needed
- ❑ Launches in seconds
- ❑ Very compact
- ❑ GNSS independent
  - indoor
  - urban areas
- ❑ Classified as not a UAS
- ❑ ± weather independent
- ❑ Safe
  - crowded locations
  - minimal impact





- ❑ Not for mapping very large areas (~ kites)
- ❑ Limited to GoPro camera
  - maybe compact cameras
- ❑ String can conflict with trees, power lines





- ❑ Universally accessible aerial photography solution
- ❑ Ideal for cultural heritage
  - excavations
  - building / ruins documentation
  - facade photography
- ❑ Many other fields
  - paleontology
  - geography / geology
  - engineering
  - journalism (e.g. BBC)
  - law enforcement





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