



Consiglio Nazionale delle Ricerche



Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni



Control Design of Unmanned Aerial Vehicles (UAVs)

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- ❖ UAVs: Unmanned aerial vehicles of different size which may be used for monitoring and detection

Without control UAVs do not fly!

✓ MARVEL Project – MicroHawk 150



✓ Italian Ministry for Research -MicroHawk 1000



✓ PNRA – Piano Nazionale Ricerca in Antartide



✓ Regione Piemonte Research Program



✓ ITHACA Program





UAVs for Fire Prevention and Natural Disaster Recognition



- ❖ Activity supported by the Italian Ministry for Research within a National Project
- ❖ **Objective:** Educational and research
- ❖ Research groups in *control*, aerospace, communication, computer engineering and government agency for fire surveillance and patrol located in Sicily
- ❖ **Task:** Construct aerial platform for remote piloting and autonomous flight
- ❖ Various sensors and two cameras (color and infrared)
- ❖ Speed: 10-17 m/s, flight endurance of 40 min



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MH1000 Platform

❖ MH1000

❖ Wingspan: 1 m; weight: 1.5 Kg

❖ Ground station

❖ Communication protocols/software



Platform based on the MicroHawk configuration developed at Department of Aerospace Engineering, Politecnico di Torino



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Prototype Manufacturing Performed by Students - 1



raw material





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Prototype Manufacturing Performed by Students - 2



working instruments



cutting machine



lifting surfaces outline



slide outline



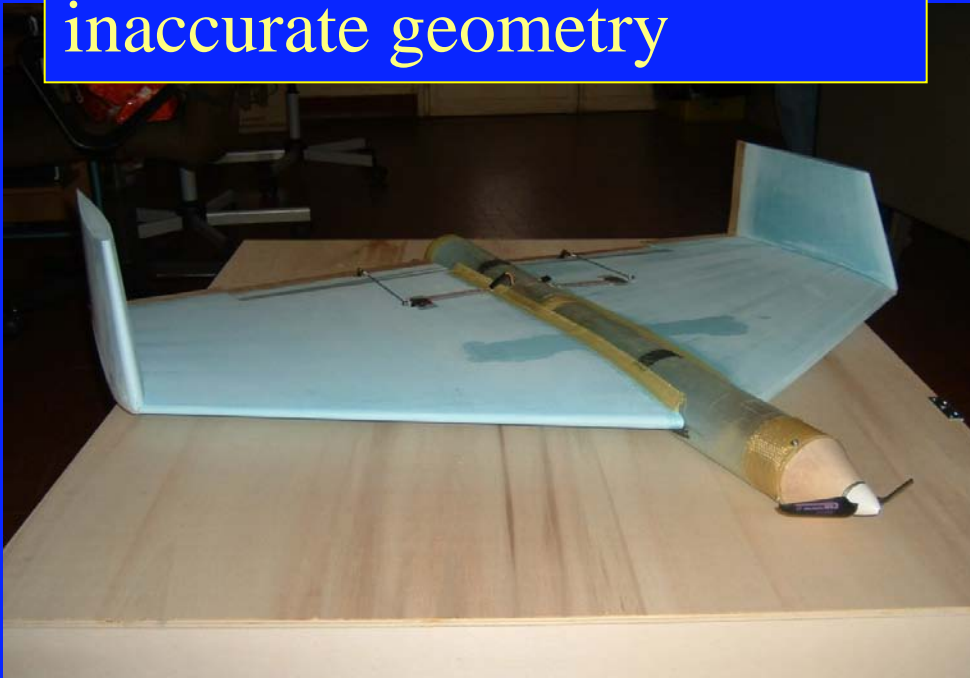
fuselage reference



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Prototype Manufacturing Performed by Students - 3

easy and cheap construction
rapid manufacturing
bad model reproducibility
inaccurate geometry

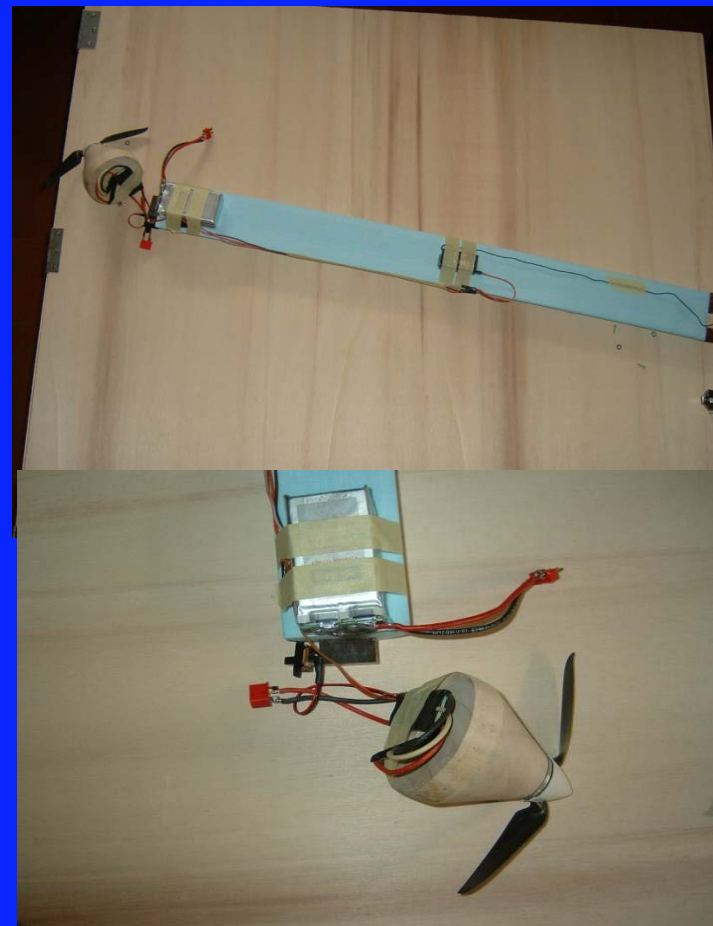




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Prototype Manufacturing Performed by Students - 3

control design and
stabilization in the presence
of uncertain parameters





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Right Turn and Landing



L. Lorefice, B. Pralio and R. Tempo, “Randomization-Based Control Design for Mini-UAVs,” Control Engineering Practice, 2009



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MH2000: Monitoring Archaeological Sites

- ❖ MH2000
- ❖ Wingspan: 2 m; weight: 7 Kg (electric engine)



E. Capello, G. Guglieri and F. Quagliotti, "A Software Tool for Mission Design and Autopilot Integration: an Application to Micro Aerial Vehicles," Euro-SIW 2008 - European Simulation Interoperability Workshop, 2008



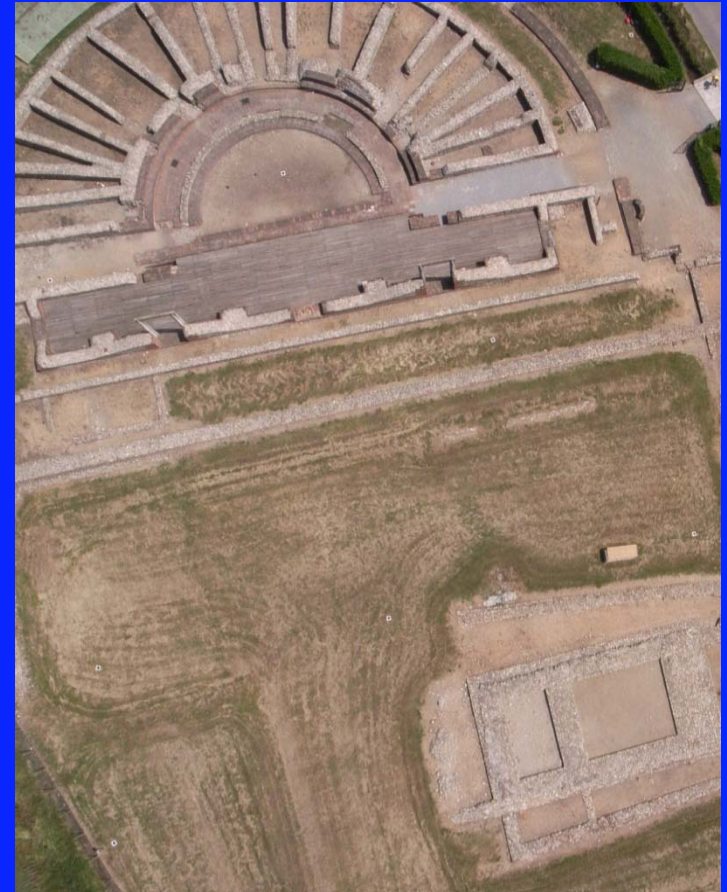
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MH2000: Monitoring Archaeological Sites



❖ Archaeological site: Roman city

Bene Vagienna (*Augusta Bagiennorum*)





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MH2000: Monitoring Archaeological Sites



Archaeological Sites Monitoring, F. Quagliotti, ITHACA, 2008



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MH850 and MH600: Formation Flight



❖ MH850

- ❖ Wingspan: 0.85m; weight: 0.8 Kg



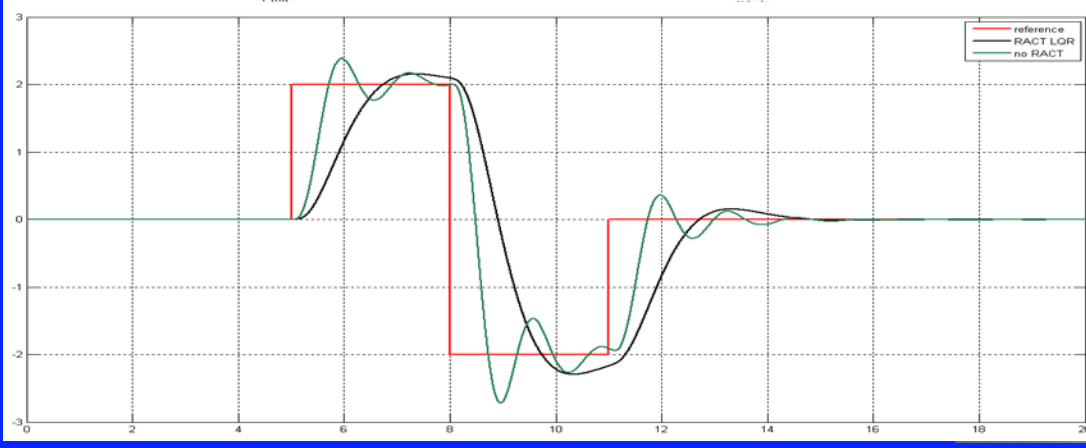
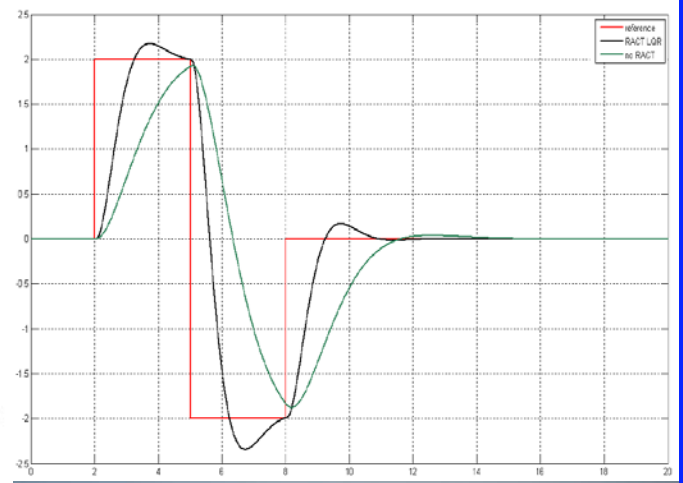
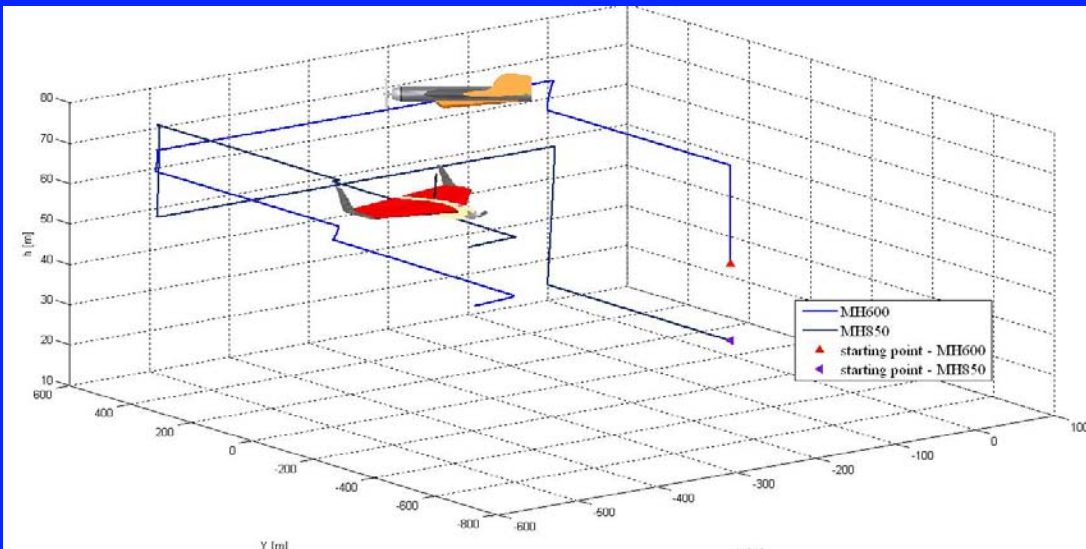
❖ MH600

- ❖ Wingspan: 0.60 m ; weight: 0.62 Kg

- ❖ Needs to control more than one platform (leader – follower formation) in the presence of uncertainty
- ❖ **Uncertainty:** distance and angles between UAVs
- ❖ **Challenges:** controllers that are optimal, robust to uncertainties and flexible to fast dynamic changes
- ❖ Altitude is maintained constant without altitude hold loop

E. Capello and R. Tempo, “Monte Carlo Algorithms for Stabilization and Control of UAVs Formation Flight”

MH850 and MH600: Formation Flight





- ❖ UAV projects for education and research
- ❖ Importance of systems and control technology

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