Workshop on Assured CPS Autonomy for 3D Urban Transportation: Drones, Flying Cars, and Beyond

June 9-10, 2021

https://cps-vo.org/group/3D-urban-transportation-workshop

Held virtually in June 2021, postponed from March 2020

NSF-PIRE Workshop : US-Germany CPS Collaborations

Assured CPS Autonomy for 3d Urban Transportation: Drones, Flying Cars and Beyond

~~March 5-6, 2020 | Berkeley, CA~~ June 9-10, 2021 Virtual

There has been a tremendous amount of interest in the industrial community in the development of personal air transportation. These are low passenger count, semi-autonomous aircraft which are capable of operating in an urban environment so as to provide the third dimension to reduce transit time in congested urban areas. It is envisioned that air space above major transportation corridors such as freeways and subway/railway tracks will be used as air-corridors for such airborne people movers. While there is a huge amount of work on issues surrounding vertical and/or short take-off and landing (V/STOL) airframes and electrically powered aircraft, there has been less attention paid to the levels of autonomy, centralization/decentralization needed as well as air traffic management issues. We propose to have a workshop to flesh out the issues in developing the technology and policy enablers for 3D Urban Transportation.

On behalf of the planning committee, we invite you to participate in the workshop. Attendance at the event is by invitation only and limited because of time and space constraints. To accept our non-transferrable invitation, please register by Friday, February 14th with the code at Golden Bear at https://cps-vo.org/group/3D-urban-transportation-workshop.

The workshop will take place at the University of California, Berkeley from March 5th to 6th, 2020. We will convene at 9:00am on Thursday morning at Blum Hall, Room 330, Berkeley, CA and conclude by noon Friday.

ORGANIZATION
Shankar Sastry, University of California, Berkeley
Claire Tomlin, University of California, Berkeley
Janos Sztipanovits, Vanderbilt University
Werner Damm, University of Oldenburg
Alexander Pretschner, Technical University of Munich

The workshop is organized by the joint US-German project on "Science of Design for Societal Scale Cyber-Physical Systems" funded by the NSF Partnership for International Research and Education Excellence (PIRE) program, co-funded by the German DFG.

Schedule

I: Industry Perspective

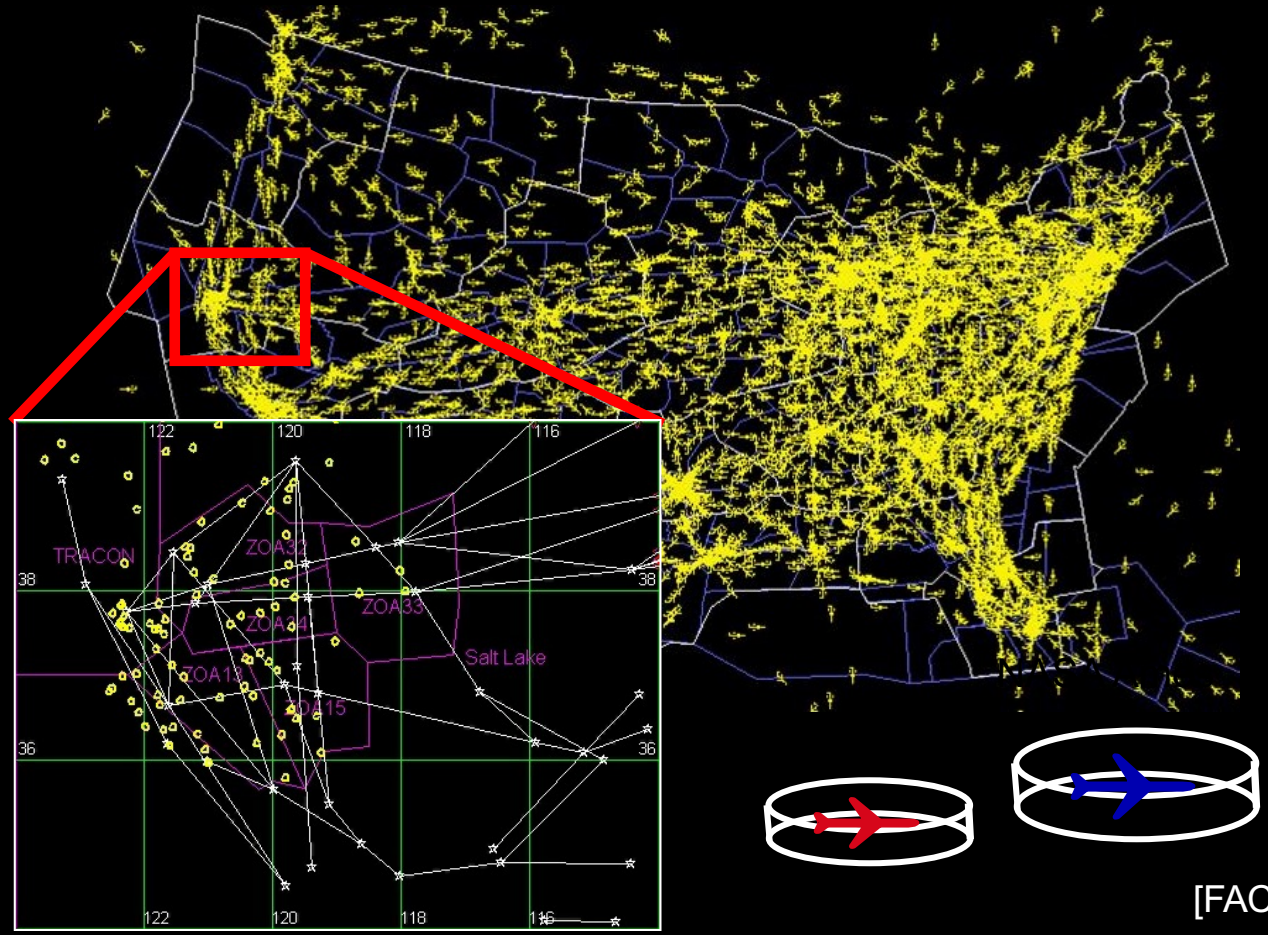
II: Policy Implications Panel

III: Assured Autonomy

IV: Airspace Structuring

V: Protocol Design and ConOpts

Air Traffic Control



[FACET, ETMS, NASA Ames]

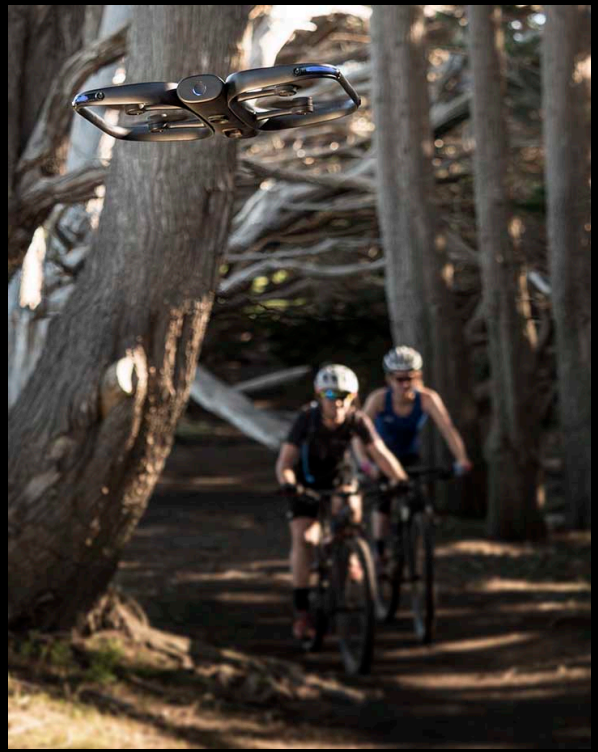
Growing numbers of UAV applications

[Amazon]

[Zipline]

[Google]

1. Safety
2. Performance
3. Simplicity
4. Adaptation



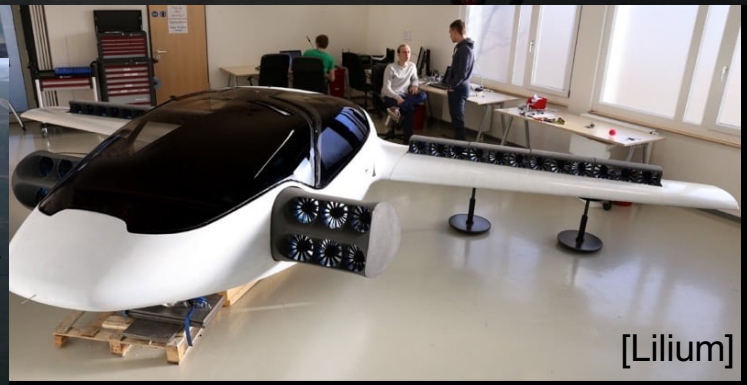
[Skydio]

New Vistas: Autonomous flight for new aircraft


[AeroMobil]


[Kitty Hawk]


[Wayfinder]


[Lilium]

[AeroVelo, Aurora, Vahana, Terrafugia…]

Session I: Industry Perspective (Damm and Corman)

Keenan Wyrobeck (Zipline)
Brendan Groves (Skydio)
Arne Stoschek (Acubed/Airbus)

- Autonomy, and how it works with humans
- Air space structuring
- Regulation issue in US
  - Part 107: designed for flights within visual line of sight
  - Type certification, crewed passenger aircraft – slow
  - Nothing in between
  - Need a pathway for streamlined flights beyond line of sight
  - European Aviation Safety Agency (EASA): “specific category”: allows routine, scalable flights beyond line of sight, primarily industrial inspection
- Crewed passenger aircraft – pilot shortage projected, need safe autonomy

Session II: Policy Implications (Nonnecke)

Brandon Stark (UC Center of Excellence on UAS Safety)
Janet Napolitano (Goldman School of Public Policy, UC Berkeley)
Peter de Vries (Twente, Psychology of Conflict, Risk and Safety)
Christian Eschmann (UAS Coordinator at DLR)

- Policy issues related to automation and airspace structure
  - Privacy
  - Security
  - Workforce
  - Public perception
- Tension between local management and the FAA
- Industrial policy in the US: reactive, not proactive

Session III: Assured Autonomy (Neema and Tomlin)

Alexander Pretschner (TU Munich)
Naira Hovakimyan (UIUC)
Evangelos Theodorou (Georgia Tech)
Marco Pavone (Stanford)
Xenofon Koutsoukos (Vanderbilt)
Bernd Finkbeiner (Saarland)
Alessandro Pinto (Raytheon)

- Testing
  - Integrating ML: "testing the untestable“
  - Closed loop testing, and sampling techniques to find rare / corner cases
  - Role of simulation in generating test cases
- Safety by Design
  - adding structure to ML models, to enable analysis and verification
  - create dynamics that embed safety: constrained vs. unconstrained
  - modular vs. e2e architectures
  - information processing architectures: making uncertainty a player, role of timing
  - formalizing aleatoric vs. epistemic uncertainty
  - combining offline vs online assurances, and prior knowledge with learning
- Real-time certification, and roles of perception, perceptual uncertainty, prior knowledge

Session IV: Air Space Structuring (Bayen & Sztipanovits)

Parimal Kopardekar (NASA)
Dasom Lee (Twente)
Karthik Gopalakrishnan (MIT)
Mark Mueller (Berkeley)
Tobias Biehle (Technical University Berlin)

- Enable scale while maintaining safety
- Service based architecture: flight planning, communication, navigation, rerouting, conflict avoidance
- Supplemental data providers: 3D maps, weather
- Fairness in demand for airspace resources, delay propagation, using queues and rules of the road
- Trading off fairness and efficiency, and doing it in a way that preserves privacy
- Tensions between {small, quiet, safe, electric} and {capabilities, range}
- Policy is too slow to be proactive; requires tests, experimental data to be effective

Session V: Protocol Design and ConOps (Koutsoukos and Finkbeiner)

Alex Bayen (Berkeley)
Banavar Sridhar (NASA)
Lillian Ratliff (UW)
Forrest Laine (Berkeley)

- Large experiment in mixed autonomy traffic (Nashville, Summer 2021): to test if you had only 5% of autonomous vehicles, can you improve the energy efficiency of the traffic
  - Communications and architecture still to be finalized
- Fairness and bias in algorithms, should promote equity
- Integration of safety measures into learning-based components, such as perception algorithms

Concluding Remarks

- ATM/UTM domain, urban areas
  - importance of autonomy in UAV applications
  - importance of local management
  - security, where should the emphasis be?
  - regulatory environment <-> technology interdependence
  - safety assurance issues requires co-designing the two sides
- Viable solution for safety and security assurance
  - Examining societal expectations on fairness/equity, confidentiality/privacy, risk, community concern …
- Differences between US and German approaches
  - development of UTM/ATM technologies that can be adapted to very different social expectations
- Thanks to NSF, and Katie Dey and her team