Task 52
LAC Summer Games 2024

David Schlipf and the Lidar-Assisted Control working group of IEA Wind Task 52
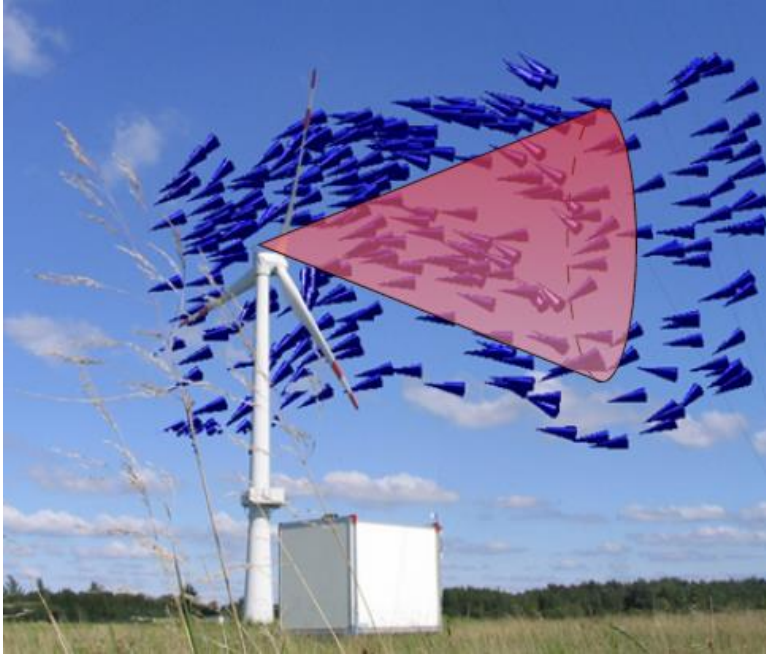
Motivation Lidar Assisted Control

- wind is changing over space and time
- conventional control reacts after impact
- lidar technology provides wind preview
- better control performance is expected

➢ Biggest market: one lidar for every wind turbine!
➢ Main idea for working group: make application easy!

Key facts about the LAC working group

- ## Objectives
  - Push the technology by transparency and Open Source Tools
 - Recommended Practices on Lidar-Assisted Control

- ## Approach
  - Monthly conference calls
  - Work together on code and documents
  - Webinars
  - Organize joined exercises: The LAC Summer Games 2024

- ## Participants:
  - 33 active members
  - From 9 countries (China, Denmark, France, Germany, Italy, Japan, Spain, UK, USA)
  - 14 more in mailing list

Task 52 working group

■ Lidar OEM ■ Turbine OEM ■ Consultancy ■ Research

Values in pie chart: 18, 8, 7, 14
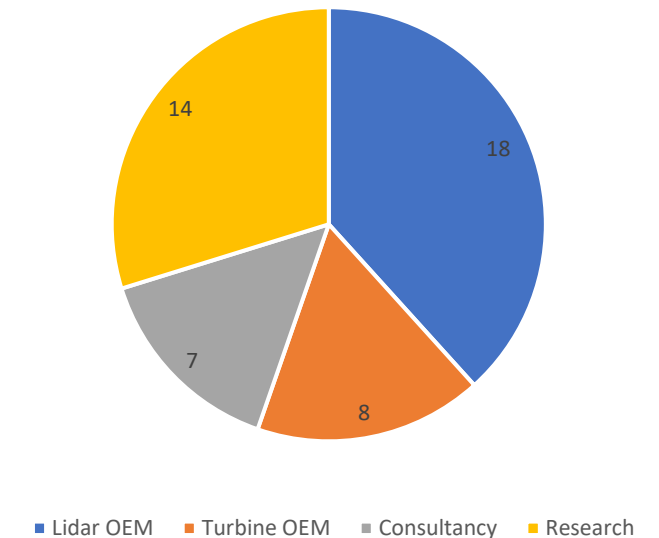
Main Idea

- Together learn from the Open Source tools
- Benchmarking of concepts
- Develop new ideas
- Share enthusiasm with students

- 2 categories (teams possible)
  1. Students
  2. Researchers

- 3 different disciplines
  1. The 30 s sprint
  2. The 18 m/s hurdles
  3. The DLC 1.2 Marathon

LAC OpenSource Tools

- At https://github.com/IEAWindTask52/LidarAssistedControl
- Based on repository from Feng Guo developed within LIKE project [1]
- Extended to a tutorial paper at ACC [2]
- Matlab/Python for simulations, Fortran for DLLs
- Currently 5 examples (in Release folder)
  - IEA15MW_01: For "30 s sprint"
  - IEA15MW_02: EOG for FOWT
  - IEA15MW_03: For "18 m/s hurdles"
  - IEA15MW_04: Turbulent wind FOWT
 - IEA15MW_05: For "DLC 1.2 Marathon"
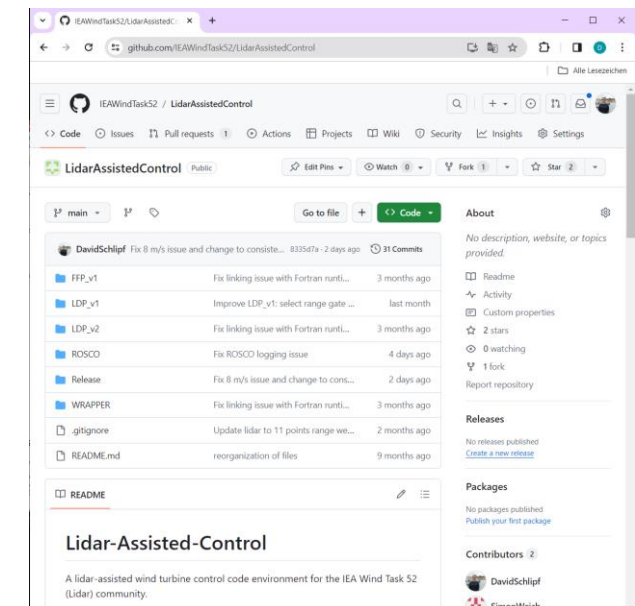
[1]   Guo, F., Schlipf, D., and Cheng, P. W.: Evaluation of lidar-assisted wind turbine control under various turbulence characteristics, Wind Energ. Sci., 8, 149–171, https://doi.org/10.5194/wes-8-149-2023, 2023.

[2]   Schlipf, D., Guo, F., Raach, S., Lemmer, F.: A Tutorial on Lidar-Assisted Control for Floating Offshore Wind Turbines, American Control Conference 2023, https://doi.org/10.23919/ACC55779.2023.10156419

The 30 s sprint

- EOG and perfect wind preview

- Reduced model (rotor and tower motion)

- Task:
  - Keep tower and rotor motion constant!
  - Improve baseline collective pitch feedforward

- Evaluation:
  - max(abs(RotSpeed - RotSpeed(t=0)) / RotSpeed(t=0) +
    max(abs(TwrBsMyt - TwrBsMyt(t=0)) / TwrBsMyt(t=0)

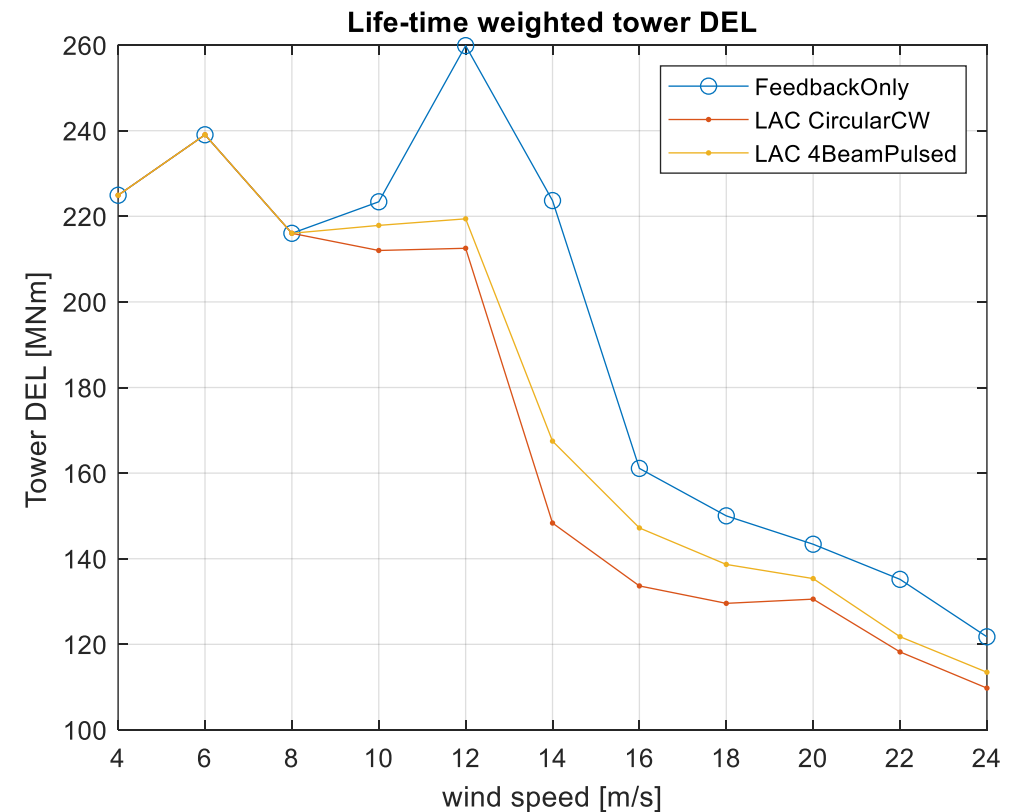- Intention: trigger new control concepts
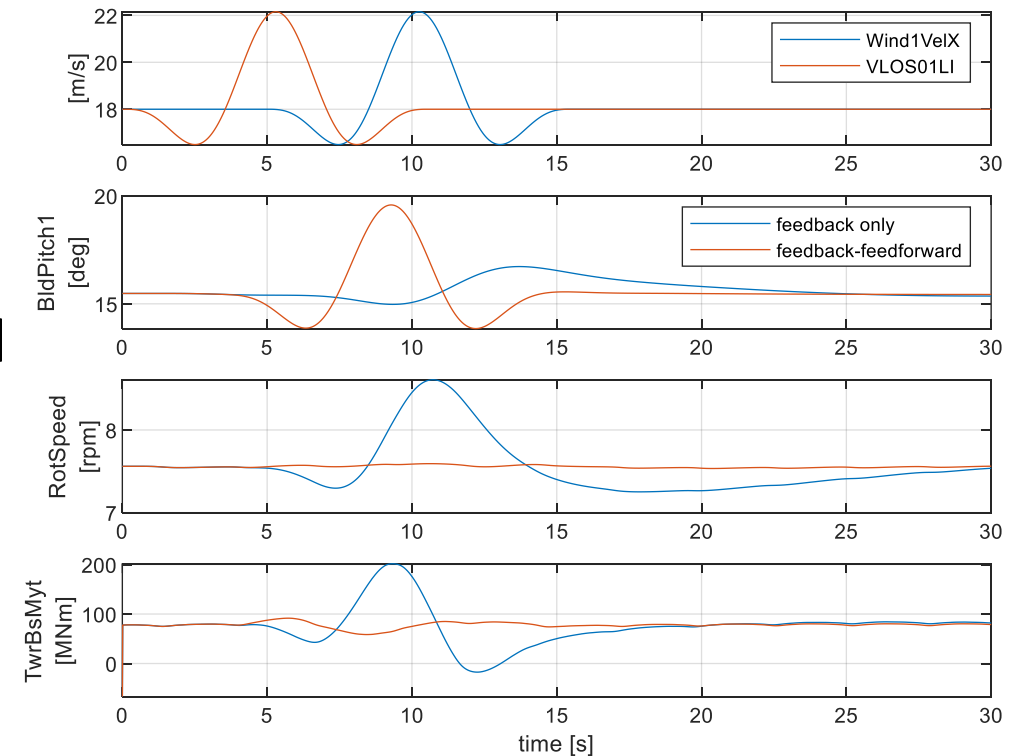
The 18 m/s hurdles

- Turbulent wind at 18 m/s, 6 seeds with 600s
- Full model and lidar-based wind preview
- Task:
  - Get the best possible wind preview!
  - Improve baseline lidar data processing!
- Evaluation:
  - Highest peak in cross-correlation between REWS and filtered lidar estimate

- Intention: trigger new lidar data processing

Cross-correlation between rotor and lidar
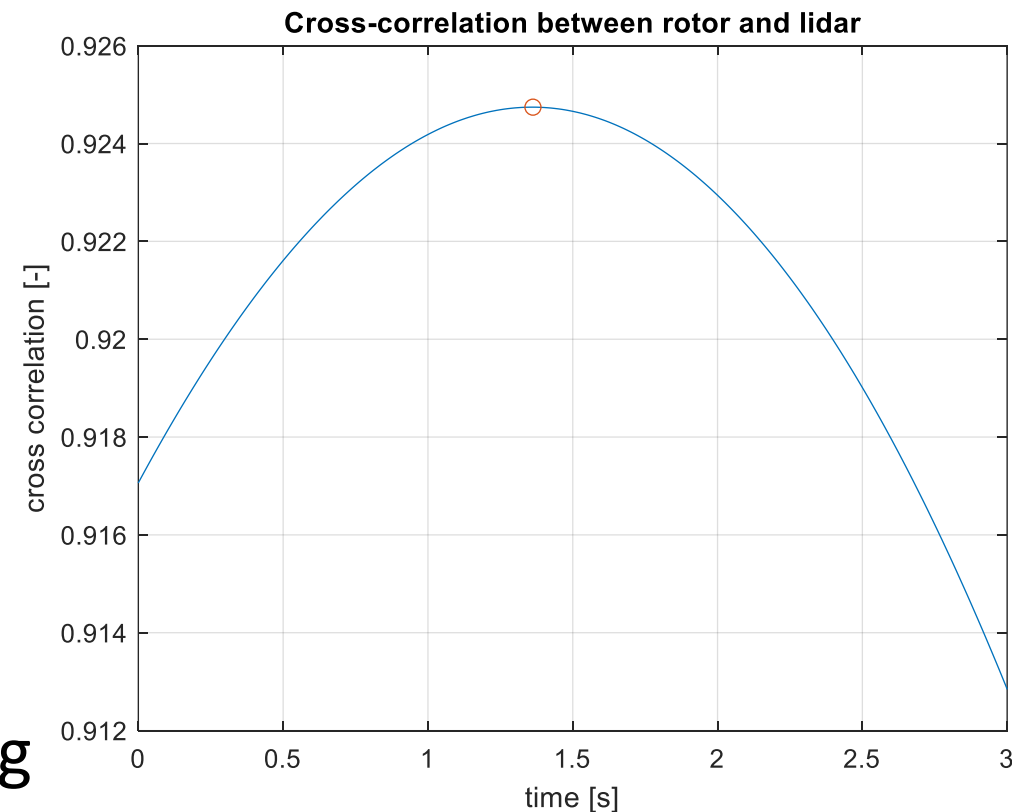
The DLC 1.2 Marathon

- 11 x 6 x 600 s simulations with turbulent wind

- Full model and lidar-based wind preview

- Task:
  - Reduce life-time costs
  - Lidar and controller can be changed
  - Improve baseline LAC

- Evaluation:
  - Minimize costs keeping constraints
  - Cost model based on Task 30 (OC6)

- Intention: benchmark full concepts

Life-time weighted tower DEL

Legend:
- FeedbackOnly
- LAC CircularCW
- LAC 4BeamPulsed

Y-axis: Tower DEL [MNm]
X-axis: wind speed [m/s]

Time line

- February 26: presentation at lunch seminar

- March 5: finalize the document

- Start: Mid march sending out the call via the task mailing list

- Duration: 2-3 months depending on participants (intended: end of summer semester for participating Universities)

- Support:
  - Use the Github Discussions!
  - Python: Simon and Aravind from WETI
  - Matlab/Fortran: David from WETI
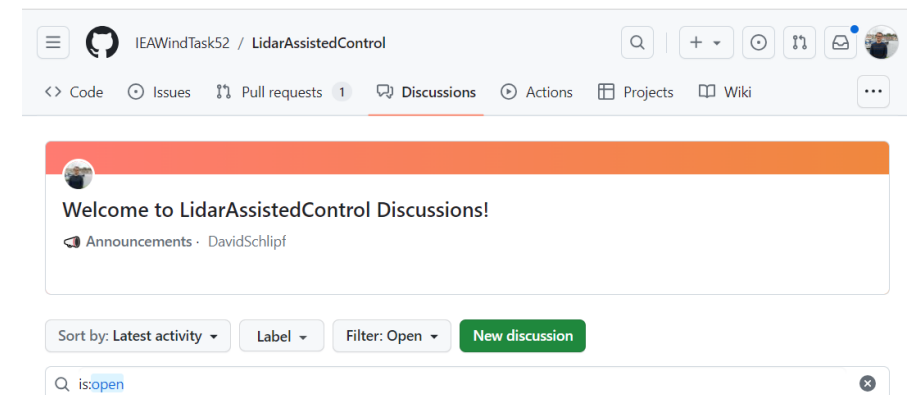
Outlook

- Evaluate the first Summer Games:
  - Publish results
  - Transfer gained knowledge to recommended practices
- Ideas for next Winter/Summer games
  - Let's make it harder! Find more realistic setups including e.g. wind evolution
  - Let's go swimming! Find disciplines for Floating Wind Turbines

How to participate?

- Try the code on GitHub, use discussions for questions!

- Register for the Task mailing list, see https://iea-wind.org/task52/ to get the invitation or follow the task on LinkedIn.

- Join the next working group meeting (send email to David) on March 5, Noon CET.

- Mobilize your students and colleagues!