

## PhD Project

### Vision-based model predictive control

The unmanned aerial vehicles (UAV) constitutes the ideal platform for many robotic tasks e.g. exploration, mapping, and surveillance. The flight of UAVs may operate under remote control or autonomously by onboard computers. It is appealing when the UAVs are able to navigate based on perceptions from their on-board sensors. So far, many methods have been driven for state estimation, sensor fusion, and vision-based position control of UAVs. Vision-based control is an approach that uses information extracted from the vision sensor(s) to control a plant, robot, manipulator, etc. It is worth mentioning that most reported studies do not address the internal constraints, such as actuator saturation and velocity limitation. To consider all of the constraints into the control design, model predictive control (MPC) can be taken into account.

Within this PhD topic, the student should be able to realize new approaches in this field, to extend them, to develop new ones, to extend the chair's competence in sensor fusion, vision-based control, model predictive control, and UAVs new control and navigation approaches. Experiments using the existing UAVs have to show both the functionality and the robustness of the new approaches.

The next intended research development steps concentrate on

- Sensor fusion for a navigation task
- Camera-based navigation and control of the UAVs
- Trajectory tracking using model predictive control for the UAVs
- Vision-based model predictive control and implementation on a UAV

Therefore we need students from the control and/or filtering and/or image processing fields with good understanding and programming skills in each field. If two of the three requirements are fulfilled, feel free to apply.

From the new candidate, we expect that s/he is willing to become very fast an important and valuable member of our Chair.

Therefore we expect

- i) a shown and strong expertise in related scientific fields to be integrated,
- ii) your ability and commitment to develop and validate NEW methods and approaches, and
- iii) your willingness and commitment to write scientific contributions on a world class level.

Depending on the candidate's background this can be related to approaches defined by the following keyword set (Nonlinear control, robust control, vision-based control, model predictive control, sensor fusion, ...).

In case of interest please provide beside the usual application material (CV, grades, ...) material stating that you have strong English language skills (TOEFL IBT better than 95, IELTS better than 6.5) and a detailed and described interest ONLY in the described

research fields. Your German language skills can be (if necessary) improved by language courses in parallel (for example at the Goethe Institute, Düsseldorf) (on your cost). For further information about the requirements see also the website of the Chair SRS: [www.uni-due.de/srs/prospective](http://www.uni-due.de/srs/prospective).

### **About you:**

Bachelor and Master degree in Electrical or Mechanical Engineering or Information science or Mathematics or Automation/Control (with strong interests in programming) (with clear related specification) necessary, deep interest in the field, excellent grades in related courses. Related and/or diverse qualifications can possibly also be very attractive.

### **About us:**

Chair SRS (Head: Prof. Söffker) at U DuE, Germany:

With a mix of coworkers and PhD students the Chair has a strong and long tradition in supervising academic trainees. The internal organization scheme will allow an improved organization of the academic work of the PhD students in guided groups. Academic qualification includes not only the PhD topic related work but also advising coworking students (Bachelor/Master level) based on individual qualification and skills etc.

The PhD students working in the group are financed by the university or by public funding, financed by industry projects, by their home countries or by DAAD scholarships.

### **Be aware about the time schedule of your DAAD-application:**

An application now or in September/October year 1 leads to the beginning of german language courses in May/June year 2 and start PhD research at the Chair SRS in October year 2.

In case of other application (government programs, national/university training programs):

You should be supported for more than 3,5 years. In case of support for less than 3,5 years, you should convince us based on existing international publications from the last five years.

The successful candidate is primarily directly related to:

Dr.-Ing. Fateme Bakhshander (Scientific supervisor: Prof. Söffker)

### **Next steps:**

1. Be aware of your national DAAD application deadline (which varies between February and November each year).
2. Contact [Dr.-Ing. Fateme Bakhshande](mailto:fateme.bakhshande@uni-due.de) directly by E-Mail (fateme.bakhshande@uni-due.de, subject: DAAD-Appl. VBMPC) and send copy of CV, certificates, recommendation letters as well as a first proposal (2-3 pages) about your understanding of the intended topic, your intended working schedule, the state of the art in this field as well as the deduced definition of your project. A 'copy and paste'-strategy will disqualify you immediately.

3. Be aware about the time schedule of your application: DAAD example application in September/October year 1 leads to begin language courses in May/June year 2 and start PhD research in October year 2.
4. Joint improvement of the proposal: If the quality of the project proposal is finally fitting to the groups standard (=perfect) Prof. Söffker will invite you by writing the required acceptance letter.
5. The final decision is with the DAAD committees.



Chair of  
Dynamics and Control

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