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TUM Practical Research Experience Program (PREP)

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TUM San Francisco

Technical University of Munich

San Francisco, February 25, 2019

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www.international.tum.de/sanfrancisco

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Locations in Bavaria

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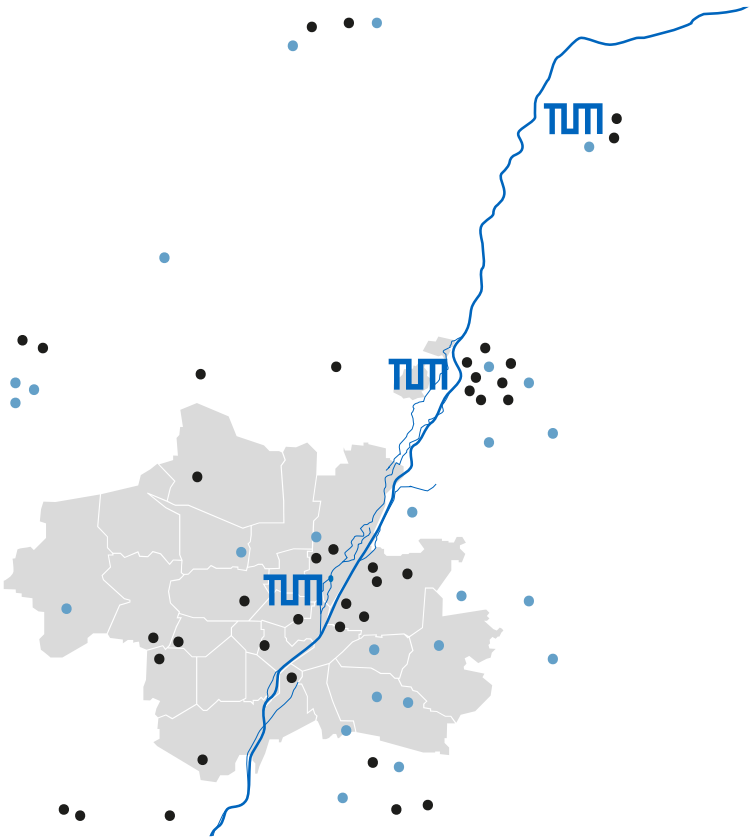
European Metropolitan Region Munich

Research Network

LMU
Universität Augsburg University
Max-Planck-Gesellschaft
IHS Hochschule für Philosophie München
DLR
Helmholtz Gemeinschaft
lrz
Universität der Bundeswehr München
Deutsches Museum
HelmholtzZentrum münchen
Deutsches Forschungszentrum für Gesundheit und Umwelt
acatech Deutsche Akademie der Technikwissenschaften
ESO
Fraunhofer



Industry Network

Continental
DRÄXLMAIER
EVONIK
HUAWEI
THE LINDE GROUP
IABG
oerlikon
KNORR-BREMSE
EPCOS
BR
BMW
BayWa
BAUER
SGL GROUP THE CARBON COMPANY
SIEMENS
WACKER
BAUINDUSTRIE BAYERN
Clariant
MAN
KUKA
MTU Aero Engines
Audi
O2
PUMA
ROHDE&SCHWARZ
Allianz
Munich RE
TDK
OSRAM
eurocopter an EADS Company
infineon
SAP
AIRBUS

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TUM at a Glance

Students
~ 41,500
35% female
29% int'l

Professors
548
2018

Faculties
14

Degree Courses
178
99 Masters
28 in English

Graduates
~ 9,500

Doctoral Theses
> 1,000

ISI Publications
~ 6,000
2016

Research Agreements
> 1,000

ERC Grants
96
Since '08

Humboldt Laureates
47
2011-15

Leibniz Laureates
18
Since '87

Nobel Laureates
17

Startups
700+
Since '90

Fundraising
~ 280M
1998 - 2016

3rd party funding
285 M
2016

Locations Abroad
7

University of Excellence since 2006

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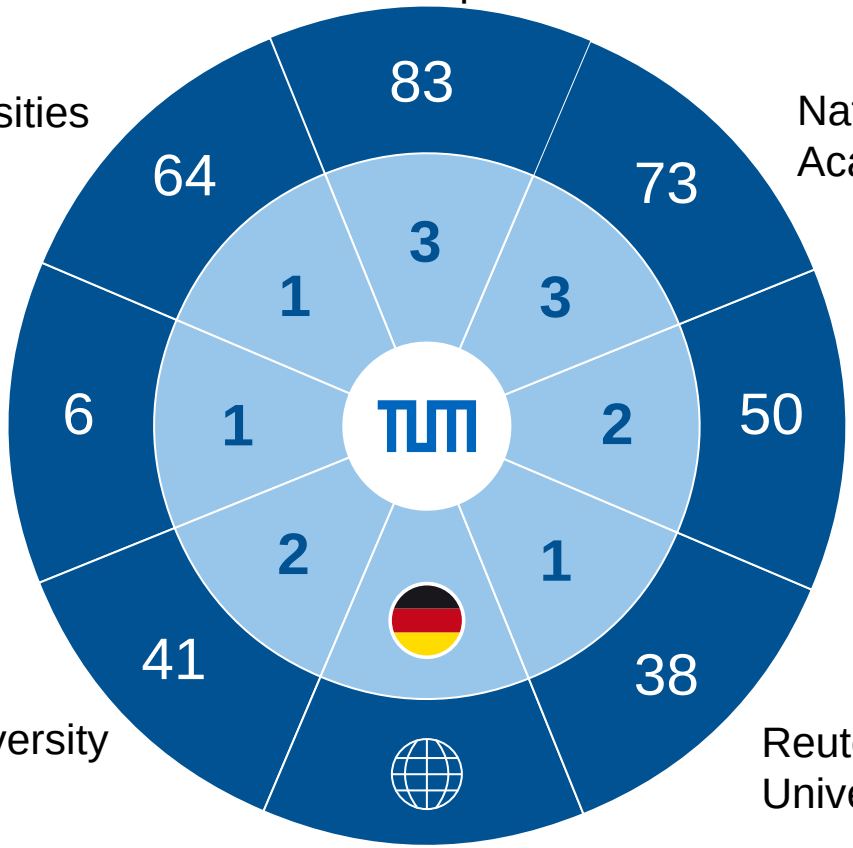
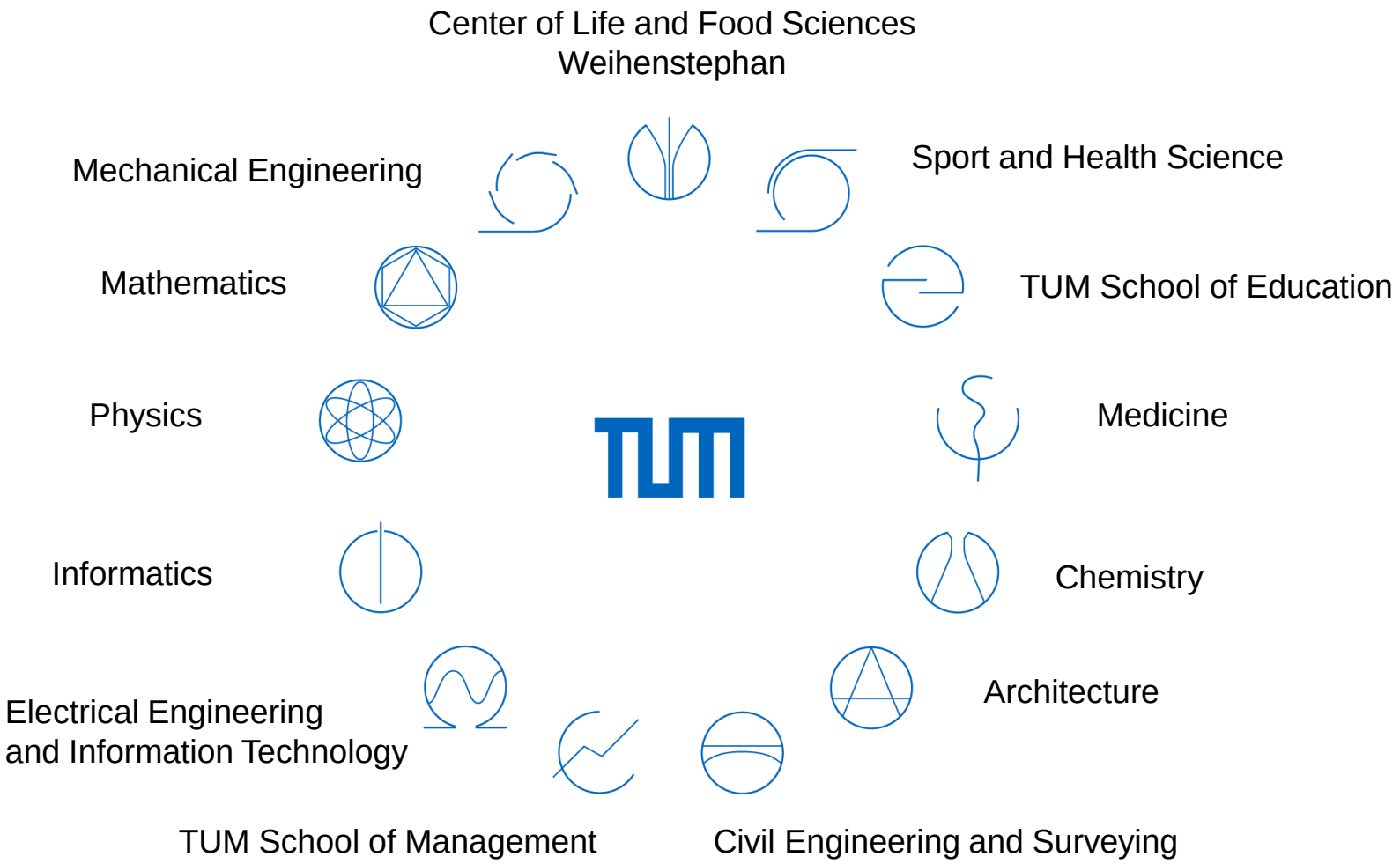
TUM in Rankings 2017/18



Departments



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PREP

Practical Research Experience Program

Your Summer in Munich, Your Research in Excellence

www.international.tum.de/en/prep

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Program Overview

(Image: Nancy Zhang / TUM)

Research Project Participation

Structured research internship program

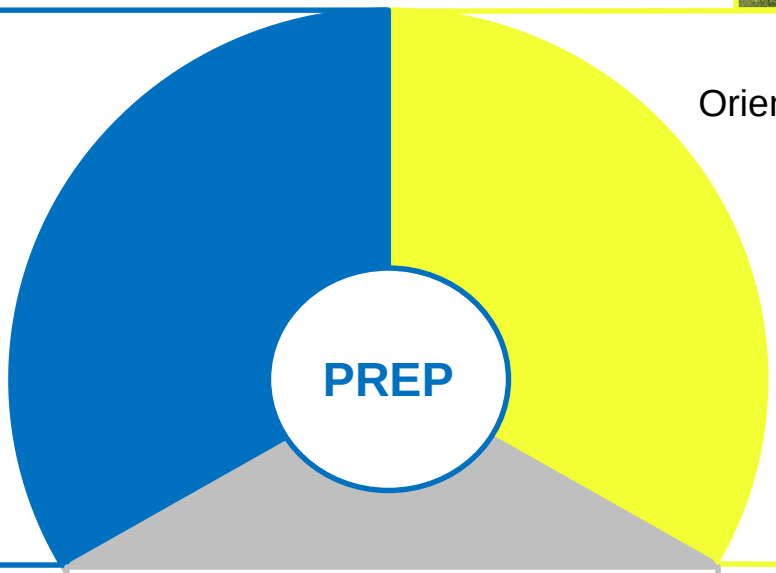
For select North American partners

Min. 10 weeks in summer

(May 28 – August 13, 2019)

Highly competitive admission process

(Image: Christina Riedl / TUM)



Framework Program

Orientation Week & PREP Events

Industry Visits

Excursions

Local Activities

Student Buddies

(Image: Ulrich Benz / TUM)

Central Services

Scholarship

Accomodation - Dorm Offer

Designated Program Manager

(Image: Ulrich Benz / TUM)

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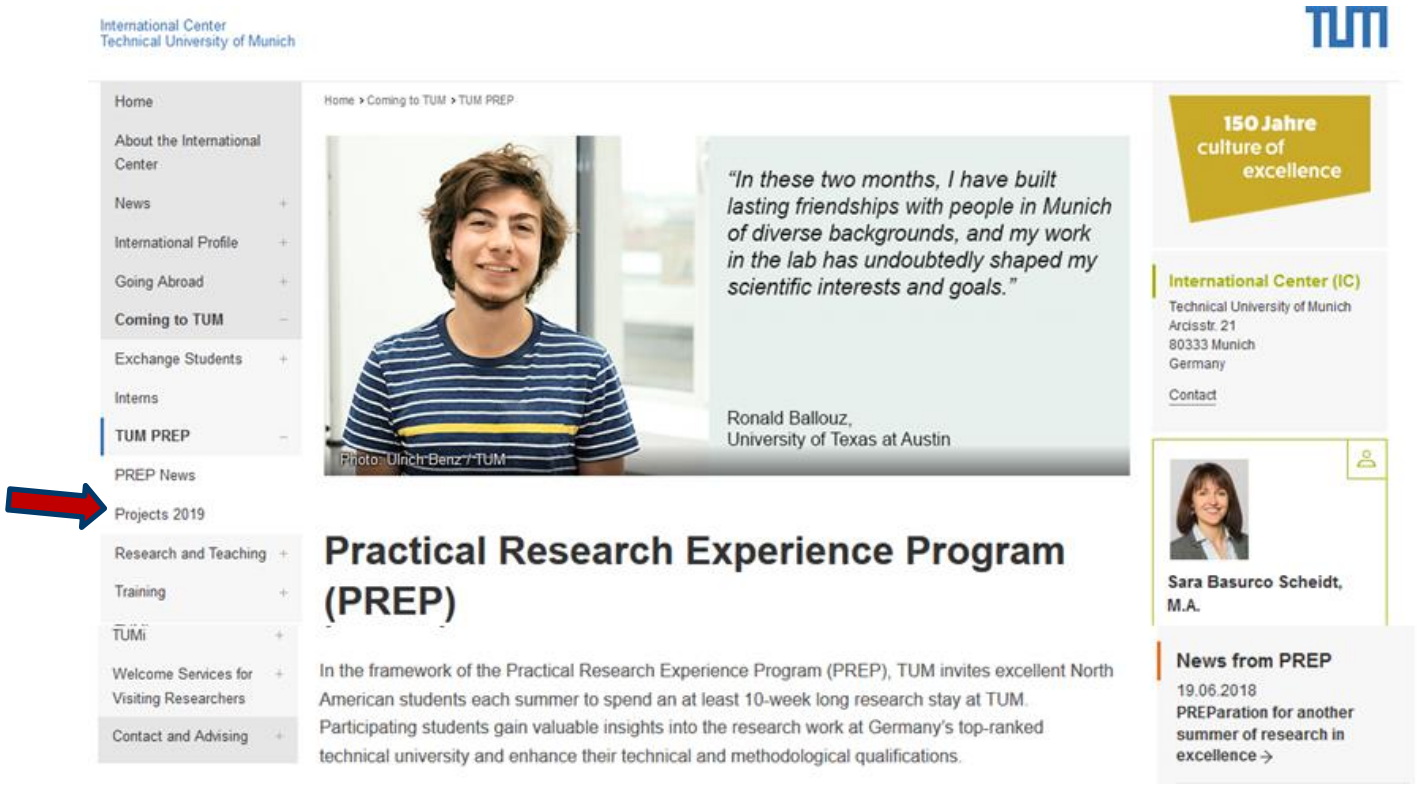
Participation Prerequisites

Candidate Prerequisites

- Undergraduate or graduate students
  (min. 2 years of undergraduate studies upon arrival)
- GPA of 3.0 or better (4.0 scale)
- Project-specific skills (for some projects)
- No German skills required

(Image: Ulrich Benz / TUM)

PREP Projects



https://www.international.tum.de/en/coming-to-tum/prep/projects-2019/

- PREP 2019: over 70 projects offered in 13 departments
- Project descriptions list specific prerequisites, required study level and planned working hours per week

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PREP Project description

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Figure: Morphing rotor under study

Project Overview				Project Code: MW 09
Project name	Neural Network-based Metamodeling for Rotorcraft Optimization			
TUM Department	Mechanical Engineering			
TUM Chair / Institute	Institute of Helicopter Technology			
Research area	Neural Networks, Multi-Disciplinary Optimization			
Student target group (departments, disciplines)	Computer Science, Mathematics, Mechanical/Aerospace Engineering			
Project supervisor(s) – Name	Dr. Juergen Rauleder, Mr. Sumeet Kumar			
Project supervisor(s) – Contact Details	E-mail:	juergen.rauleder@tum.de	Phone:	+49 89 289 16303

Project Description

Rotorcraft performance can potentially be improved using adaptive structural mechanisms that are placed on a rotor blade and actively actuated. The actuation schedule and location of these mechanisms can have significant effect on the resulting performance. For the current problem, the above helicopter (see figure) is proposed with an array of active control mechanisms installed, and the objective is to find an optimum set of design variables (the on-blade location, size and actuation phasing of different active blade mechanisms (see figure above)) that lead to best rotor performance at a given flight condition.

Each of the active blade mechanisms changes the rotor structural properties, due to presence of actuators and associated structural stiffening of the sections for additional load bearing, as well as the aerodynamic efficiency of corresponding sections. Therefore, a complete rotor optimization problem involves accounting for the aerodynamic effects of the mechanisms as well as the associated structural modifications.

A working numerical simulation model for comprehensive analysis of a (BO-105) helicopter rotor will be provided. It is a physics-based model wherein the rotor structure, the trim state and the associated aerodynamic modelling parameters are defined in detail. Upon execution, the output consists of an exhaustive set of overall performance parameters, and structural and aerodynamic loads over the entire rotor disk.

Using parametric sweeps with the aforementioned rotor analysis model to locate best design points is not practical because an optimized design would only result after analyzing a large design space, which is computationally prohibitive to investigate. Furthermore, a helicopter rotor physics problem is non-linear, and using surrogate methods for approximation makes the optimization problem tenable. However, such approximation methods can sometimes be inept in effectively modeling the high non-linearity within the problem, leading to anomalous results. Neural networks have been shown to be capable of approximating such highly non-linear functions.

Objective: This project proposes to use neural-networks-based metamodeling to approximate the given problem for optimizing helicopter performance.

Working hours per week planned (Mon-Fri, max. 40 hrs)	Flexible, based on the student's productivity and if he/she is on track to meet the project objectives.

Prerequisites

Level (at the time of arrival)	☐ Undergraduate (3rd Year)	☐ Senior Undergraduate (4th Year) or Graduate	☒ Both	
Prerequisites – Subject-related	Fundamental knowledge of neural networks and their applications is essential. It is encouraged that the project be carried out using the Python programming language; alternatively, Matlab can be used. (Knowledge of rotorcraft physics is not essential.)			

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Application and Admission

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Project supervisor(s) – Contact Details	E-mail:	juergen.rauleder@tum.de	Phone:	+49 89 289 16303

- **Application period: October 8 – November 30, 2018**
- Online Application via PREP homepage
  (at least 2 ranked project priorities possible)
- *Pre-selection by partner universities possible*
- TUM International Center tries to place students according to their prioritizations
- Final selection done by project supervisors/ researchers
- **Admission letters: late January**

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No Program Fee!

Estimated Expenses

(total amounts for entire stay)

+ TUM Scholarship:	**$1,400** (for students not sponsored otherwise for PREP)
- Accommodation* (dorm):	~ $1000 - $2,000
- Cost of Living:	~ $700 € - $1700
- German Health Insurance:	~ $300
- Enrolment Fee*:	~ $150
- *Semester Ticket (public transport):*	*~ $230 (recommended)*
[Dorm Security Deposit*:	~ $600 (*refunded shortly after the student's stay*)]
- Travel Expenses*:	~ $1,000
- Visa Expenses* (if applicable):	~ $120

*Expenses due before arrival or in case of accommodation in most cases part of whole expense due before arrival.

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Contact

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www.international.tum.de/prep

(Image: davis – Fotolia)