<u>Suggested Master thesis topics in the FIT program:</u>

Contact person: Prof. Jan-Peter Mund

1. URBAN GREEN SPACE (UGS) detection in Phnom Penh (BMBF Research project)
   - Detecting UGS features and urban surface texture with SAR data backscatter
   - Combining multispectral and SAR RS data in order to monitor UGS and build-up infrastructure in Phnom Penh
   - Using Sentinel 2/3 and 5 to monitor the Urban Heat Island in the municipality of Phnom Penh
   - Developing a urban tree cadaster data base for urban tress in Phnom Penh

2. RS of the HNEE Martelloscopes in Eberswalde
   - Testing the 3D wearable Lidar surveys and data to build a 3D virtual forest twin structure of the Martelloskope
   - Tree segmentation in the Martelloskope using the Geoslam – algorithm
   - Monitoring the *Viscum album* (Kiefern-Mistel) in the Martelloskope of HNEE

3. Other topics:
   - Monitoring and analyzing wind throw and storm events with SAR data
   - Tree species determination with a Sentinel 1 and Sentinel 2 Data in the region of Eberswalde

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Contact person: Prof. Tobias Cremer

1. Measuring logs and log piles by using the laser device „GeoSlam“.

   Goal: Determination of the volume of logs and log piles

   Material and Methods: 1000 logs of industrial wood with a length of 3 m are to be captured with the laser device. After this, these logs will be piled approx. 100 times. That is, each time a new log pile with the same logs will be built. Each pile shall be captured with the laser device as well. From each capture a point cloud will be obtained. These point clouds are to be analysed a posteriori. From these analyses the most important data concerning the logs and log piles shall be obtained such as log diameters, taper amount of each log or the pile dimensions. Furthermore, the volume of each log and log pile shall be determined from these analyses as well.

2. Analysis and further development of a measuring gate at SwissKrono, Heiligengrabe

   Goal: Determination of the accuracy of the measuring gate, in comparison to other methods for the determination of roundwood volume

Material and Methods: Measuring roundwood load of incoming trucks with the measuring gate (more info: https://je-gmbh.de/produkte/joro-volume); comparison of the measurements with data derived using the GeoSlam Laser, with data from manual measurements and/ or with data derived from log wise determination of volume using a dip tank; if possible: further development of the algorithms of the measuring gate

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Contact person: Dr. Luis Miranda

1. Energy fluxes in a combined production of glass, biogas and mescal spirits in Mexico.

   A glass recycling facility in Mexico is improving their energy footprint by different technological means. At the same time, they produce mezcal, a local alcoholic beverage, and treat organic waste to produce biogas. The objective is to perform an energy balance to identify the possibilities of an integrated energy management.

2. Reuse of exhaustion carbon dioxide from a biogas reactor as greenhouse fertilizer.

   Biorreactors produce CO2 that could be used as a fertilizer for plant production. The objective is to evaluate the feasibility of such coupling and present alternatives for implementation.

3. Yield prediction of greenhouse tomato using deep neural models.

   Harvesting tomatos in greenhouses is a regular task that depends highly on the microclimate. For the producers, it is useful to estimate the expected amount of kilograms to be harvested for economical and logistic reasons. The objective is to develop a model (e.g. LSTM) to estimate the yield using climatic values as inputs.

4. Deep resolution mapping of satellite and remote sensing images.

   Images of satellites and UAV can represent the same geographical area with different spatial and spectral resolution. Mapping between images of the same area could improve the resolution and allow to detect objects by fusing information from different sources. A first approach could use convolutional deep neural networks.

5. Transferability of greenhouse climate models.

   All empiric climatic models are tied to the dataset used to create them, making it difficult to use them under different conditions. In the case of greenhouses, the microclimate is defined not only by the physical structure, but also the geographical location, the agronomic management and the crop itself. The ability to transfer models between facilities can foster the technology transfer in the sector.

6. Evaluation and improvement capacities of irrigation in an organic greenhouse farm.

   A particular organic farm in northern Germany produces vegetables under organic certifications. Preliminary data suggest that the irrigation (microirrigation on soil) shows room for improvement. A thorough water balance could help to make suggestions on the irrigation management.

7. Deep generative models to predict image time series.

Time series of geographical images are often used to show the evolution of land-use in a given area. Goal of this research topic is to explore the use of generative models to predict such developmments by creating images of the area, using previous instances as inputs.

8. Hydraulic design of a biorreactor for biogas production.

An hydraulic model (CFD) of a particular biorreactor is needed to improve its design, with a particular focus on minimizing its dimensions.

9. Segmentation of maize and weed for autonomous navigation.

An autonomous robot needs to be able to differentiate maize and weed in real time to be able to accurately navigate between lines in a field. For this, a segmentation and classification model of the images from the video camera is needed.

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Contact person: Dr. Evelyn Wallor

1. Systematic analysis of crop models' sensitivity with regard to their response to changed soil input variables in wheat yield modeling.

Agro-ecosystem models are increasingly used to predict crop yields at different scales, for example with respect to changing climate conditions. Especially in wheat cultivation, soil properties play an important role to achieve yield targets as they determine water and nutrient availability during the growing season. A systematic sensitivity analysis of selected crop models is applied to investigate their response to changes in soil properties and whether this reaction reflects the conditions in the real world.

2. Impact of spatial soil input data aggregation on yield simulations at the field scale.

Field scale variability of soil texture contributes to the site-specific performance of water dynamics, nitrogen turnover and crop development in the soil-plant-atmosphere system. Agro-ecosystem models predominantly operate on the basis of point information and spatially and temporally variable soil states at the field scale are rarely considered. The aim here is to investigate how the upscaling of soil information affects the accuracy of the model output on the field scale.

3. Peatland classification by using remote sensing data.

Peatlands can be classified by a range of categories, e.g. vegetation, water and nutrient status. Their special role in the global carbon cycle is widely recognized and their appearance varies depending on their geographic location. Peatlands are particularly affected by climatic changes, especially with regard to the water balance. The extent to which remote sensing information is suitable for monitoring the spatial distribution of peatlands is to be examined here.

4. Combination of sensory measured soil and plant N contents for an improved assessment of the nitrogen use efficiency at the field scale.

In precision agriculture the lack of affordable methods for mapping relevant soil attributes is a fundamental problem. It restricts the development and application of advanced models and algorithms for decision making. Using sensors with different measuring principles improves the estimation of soil fertility variables such as plant available nitrogen (N). Combining the information of an ion-selective electrode sensor to determine soil N with the output of an optical crop sensor might improve the N balance on agricultural fields.

5. Evaluation of selected machine learning algorithms for ecosystem classification based on monitoring data.

Machine learning algorithms are increasingly used to identify categories, relationships, or predictions based on sample data. In the data base of environmental ecosystem monitoring a lot of information is stored that is needed for ecosystem classification, e.g. vegetation and soil inventory. The aim is to determine the type and amount of data required to qualitatively classify ecosystems using different machine learning approaches.