PhD project: Lina Nolin

Decision Support for Real-Time Control of soil and crop amendments in agricultural production, based on sensor data, databases and model-based simulation

The population of the world is increasing rapidly and this means an increasing demand for a reliable food supply. The world as a whole has the production potential to cope with demand but there are many restrains to overcome and one of the main practices to improve agricultural and conservations practices is more efficient use of fertilisers. Today, farmers need to consider three major challenges and they are; to obtain high quality crops, to minimise production costs and to limit negative impacts on the environment. These objectives could be achieved simultaneously if the amount of fertilisers added to the soil corresponded to crop requirement. The capacity of the soil to provide nutrients to plants varies, while crop demand also varies spatially within fields. The objective of this project is to combine field background data, i.e. historical data about previous yield, crop quality, soil type, soil water content, soil nutrients etc., with sensor estimation of the current nitrogen (N) status in crop, to result in a real-time variable N fertiliser application system that add fertiliser according to within-field differences in crop demand and risk for losses. In order to facilitate the background data handling, a soil and crop model will be operated in conjunction with the crop sensor. Thus, the ability of the sensor to sense current N demand is combined with the ability of the model to predict coming N demand.
The overall aim of the project is to develop a framework for real systems to control variable N-fertilizer application, on the basis of economical and environmental criteria that can handle models and sensors in real-time with respect to robustness, speed and precision, and thus contribute with practical solutions in applied precision agriculture. The future work will be based on the objectives if this project, which are to:

- Identify and validate relevant data sources and models that can interact with N-sensor measurements in real-time for economical and environmental optimization of N-fertilizing
- Develop interfaces between background models and real-time data for precision agriculture to facilitate variable application
- Investigate how the relationship between analytical accuracy and spatial resolution in background data influence accuracy and resolution of the real-time model.

The combination of different agricultural data, originated from different sources and times and the transformation of these data into a representation that can provide decision support, will make use of the data fusion concepts. Historically, data fusion methods were developed in and for military applications, but lately the methods have spread and have been used for civil engineering applications so today the transference of technology occur between many application areas and at many levels of data fusion.

Detta doktorandprojekt är ett samarbete mellan Högskolan i Skövde och SLU.