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Utilizing Spatial Uncertainty of On-The-Go Measurements to Design Adaptive Sampling of Soil Electrical Conductivity in a Rice Field

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Abstract : The main reasons for site-specific management for agricultural inputs are to increase the profitability of crop production, to protect the environment and to improve products' quality. Information about the variability of different soil attributes within a field is highly essential for the decision-making process. Lack of fast and accurate acquisition of soil characteristics remains one of the biggest limitations of precision agriculture due to being expensive and time-consuming. Adaptive sampling has been proven as an accurate and affordable sampling technique for planning within a field for site-specific management of agricultural inputs. This study employed spatial uncertainty of soil apparent electrical conductivity (ECa) estimates to identify adaptive re-survey areas in the field. The original dataset was grouped into validation and calibration groups where the calibration group was sub-grouped into three sets of different measurements pass intervals. A conditional simulation was performed on the field ECa to evaluate the ECa spatial uncertainty estimates by the use of the geostatistical technique. The grouping of high-uncertainty areas for each set was done using image segmentation in MATLAB, then, high and low area value-separate was identified. Finally, an adaptive re-survey was carried out on those areas of high-uncertainty. Adding adaptive re-surveying significantly minimized the time required for resampling whole field and resulted in ECa with minimal error. For the most spacious transect, the root mean square error (RMSE) yielded from an initial crude sampling survey was minimized after an adaptive re-survey, which was close to that value of the ECa yielded with an all-field re-survey. The estimated sampling time for the adaptive re-survey was found to be 45% lesser than that of all-field re-survey. The results indicate that designing adaptive sampling through spatial uncertainty models significantly mitigates sampling cost, and there was still conformity in the accuracy of the observations.

Keywords : soil electrical conductivity, adaptive sampling, conditional simulation, spatial uncertainty, site-specific management
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