Remote Sensing: A Combined Big Data and IoT Tool for Precision Agriculture

T. George[1*], and S. Nozaki[2]

[1]SaraniaSat Inc., Los Angeles, CA, USA

[2] Graduate School of Informatics and Engineering, The University of Electro-Communications, 1-5-1 Chofugaoka, Chofu-shi, Tokyo, Japan

*E-mail: tom.george@saraniasat.com; +1-(818) 790-2672

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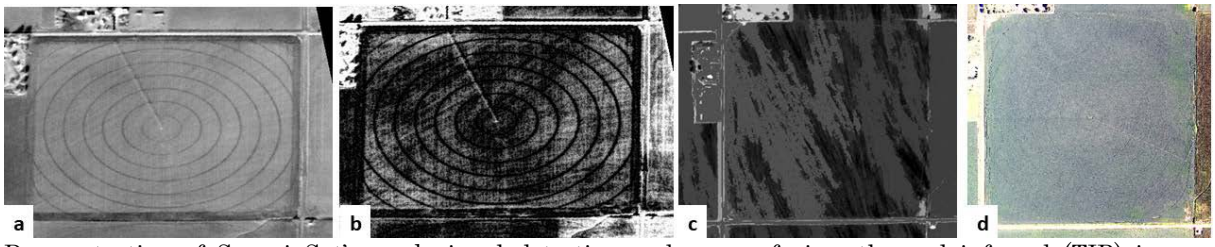

Demonstration of SaraniaSat's weak-signal detection and sensor fusion, thermal infrared (TIR) image processing capabilities for aircraft remote sensing imagery (1m ground resolution) of a soybean field near Lincoln, Nebraska in 2017. (a). Nighttime, broad-band (8-12 μm) TIR raw image is mostly featureless. (b) Application of SaraniaSat's weak-signal detection processing enhances image contrast, clearly showing higher biomass (brighter regions) and lower biomass (darker regions). (c) Fusion of contrast-enhanced daytime TIR imagery with nighttime TIR imagery clearly shows regions of high crop stress (dark regions) and low crop stress (light regions). (d) By comparison, a visible (RGBN) simultaneously acquired of the same soybean field show no significant contrast features.

Since the advent of agriculture almost 15,000 years ago, mechanization has been rather recent development mostly occurring in the previous century. The new millennium promises a revolution in Precision Agriculture, perhaps leading up to completely automated farms. This is a very timely development since projections of global population are estimated at 9.5-10 billion by mid- century. Hence, it has becoming apparent that increasing food production will soon become an existential problem.

It is well recognized that daily farm management activities are rather intricate operations requiring a high degree of complexity in the data and information that is ingested by the decision maker, typically the farmer. For the development of effective Precision Agriculture-based farm management systems, it is important to both acquire and rapidly process complex data and information at the front end resulting in relatively simple actions involving the adjustment of crop inputs such as the application of irrigation, fertilizer and crop-protection products for maintaining crop health and ultimately ensuring high harvest yield. Therefore, to implement an effective remote-sensing based farm management system, decision-support information should be "actionable" on a daily level and at the field scale. Thus, remote-sensing data requires high spatial, temporal and spectral resolution. Subsequently, as shown in the figure above, advanced algorithms are required to enhance image contrast by extracting the desired weak signals and fusing multiple images containing "orthogonal" or complementary information to provide simply interpretable and robust decision support. Finally, since data and information can become "stale" very quickly, delivery to the farmer within 24 hours of acquisition is crucial.

References

1) S.L. Martin and T. George, "Applications of Hyperspectral Image Analysis for Precision Agriculture," to be published, Proceedings of the SPIE, (2018).