

A Remote Automated Optical Field Sampling System based on the UniSpec-DC Equipped with a Wireless System

For remote locations, a reliable and repeatable field sampling method is needed for monitoring ecosystem processes for various scientific reasons (e.g. ground truthing, link vegetation indices to ecophysiological variables) (Claudio et al., in press; Fuentes et al., in press, Cheng et al., in press). To ensure that the data are collected continuously, and to collect the data during severe weather (e.g. in Arctic or in the desert), an automatic wireless setup is strongly demanded. A research group directed by Dr. John A. Gamon at California State University, Los Angeles has used a tram system (**Figure 1**), consisting of a dual-detector spectrometer (**UniSpec-DC**) mounted on a robotic cart for mobile sampling of ecosystem spectral reflectance together with a wireless system. With this system, the group was able to collect data in Barrow, AK and Sky Oaks in Southern California for the last six years (Cheng et al., in press, Gamon et al., in review). This system allows them to collect data in order to analyze key factors affecting ecosystem ecophysiological and optical properties. The tram system is designed to monitor environmental conditions using a variety of environmental sensors and on-board datalogger and remotely sensed vegetation indices using the highly portable **UniSpec-DC** system (**Figure 2**).

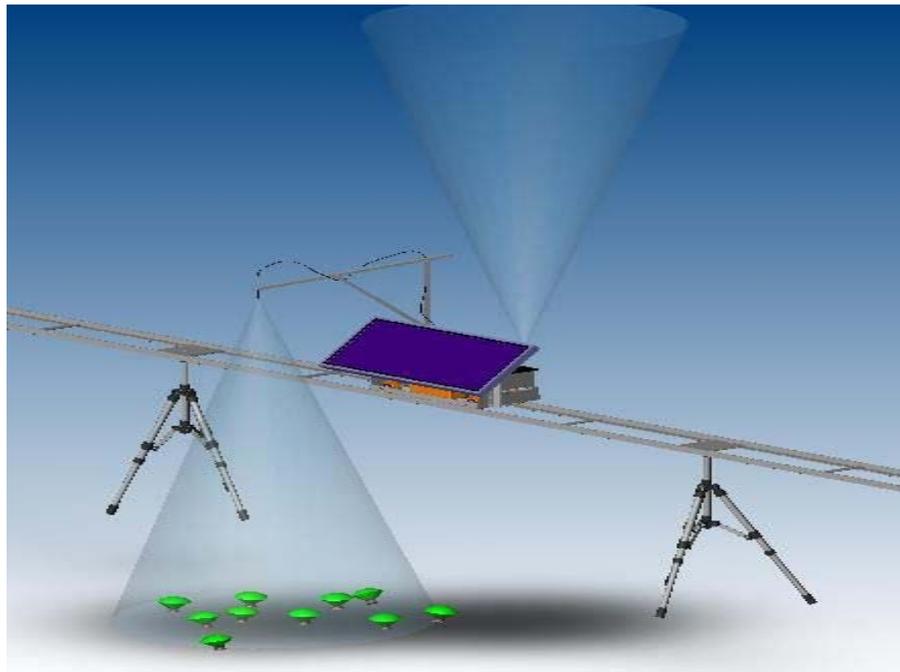


Figure 1 - Schematic of tram system, together with UniSpec-DC, sampling of upwelling and downwelling radiation (illustrated by cones), allowing Sky condition correction and wireless remote operation. (Drawing courtesy of Jose Cano at California State University, Los Angeles).

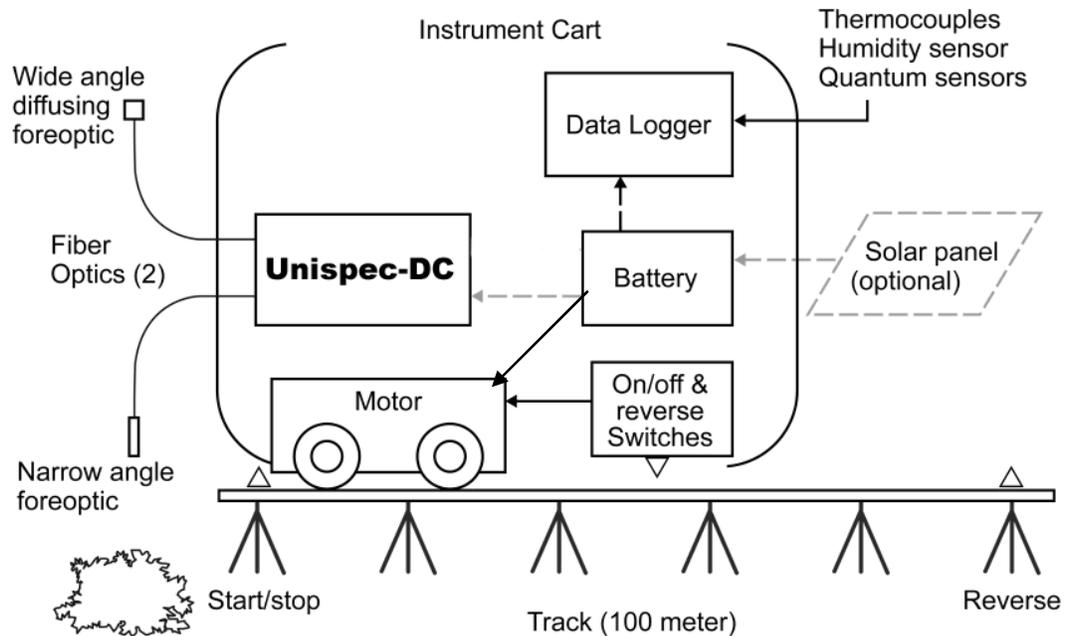


Figure 2 - Schematic of instruments (e.g. **UniSpec-DC** for ecosystem optical property sampling and datalogger for all the environmental monitoring sensors) aboard the tram system. (Drawing courtesy of Loren MacKinney at California State University, Los Angeles, CA).

With the wireless setup, the user is able to monitor the equipment in multiple carts, retrieve the data, and control the cart from a remote site via a wireless connection. The wireless connection is an 802.11 b/g link from each cart to the central router located at the Base Station/Control Shed.

Wireless Network SSID: Local Network Name (e.g. BarrowTramNet)
 Router IP Address: **XXX.XXX.XXX.XXX**

Each cart contains a Moxa™ serial-to-WiFi Ethernet transceiver. This module is a transceiver with multiple serial ports. These ports connect to the serial ports of the BASIC Stamp (if applicable), spectrometer, and datalogger. The antenna is mounted on the mast and is connected to the antenna port of the Moxa radio via an SMA cable. The Moxa radio requires a minimum of 12V to operate; hence care must be taken to ensure that the cart's 12V battery is fully charged. The wireless setup is illustrated in **Figure 3**.

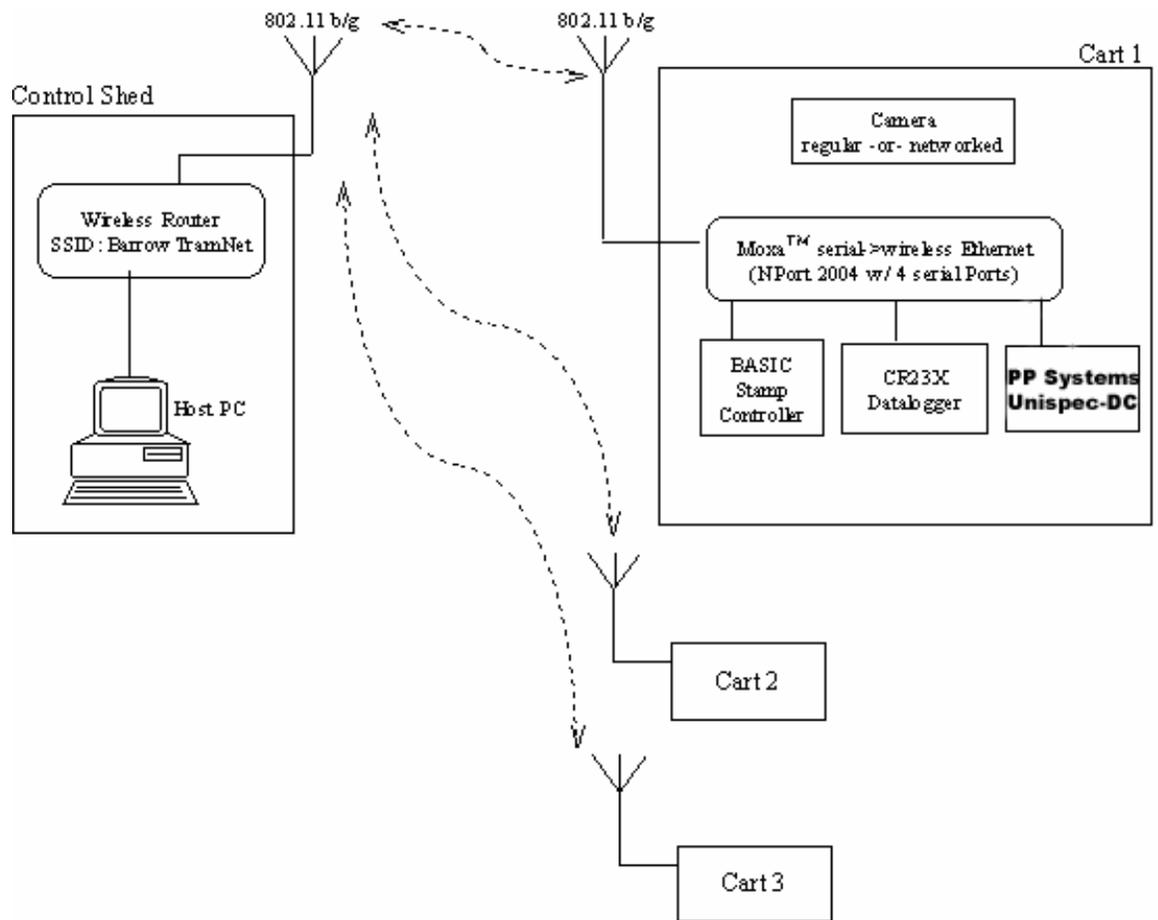


Figure 3 - Schematic of wireless connection (e.g. **UniSpec-DC** and datalogger for all the environmental monitoring sensors) aboard the tram system. (Drawing courtesy of Faria at California State University, Los Angeles)

The **UniSpec-DC** is operating on a Windows CE platform and the system is modified for the instrument operational purposes. Here are the instructions on how to set up NetOp to communicate between the **UniSpec-DC** and a remote controlling computer:

UniSpec-DC Integrated U/I Wireless Upgrade Procedure

NOTE: This causes the installation of Cisco Aironet 350 Wireless Adapter Card Drivers v2.7 and NetOp Host v8. If you are not using the Cisco Aironet 350 card or have not purchased a NetOp Host v8 license, then following these instructions may not be appropriate.

General Preliminaries

1. Using a USB cable make a ActiveSync connection between your desktop computer and the UniSpec-DC Integrated U/I to be upgraded.
2. Using Windows Explorer, create the following subdirectories on the U/I:
 \Mobile Device\FlashFX Disk\Startup\ADSCopy\CSCO
 \Mobile Device\FlashFX Disk\Startup\ADSCopy\NTOP

Cisco Drivers

1. UnZip the archive Ciscov27.zip in a temp directory on your desktop PC.
2. Copy the file PPCopy_CSCO.inf to \Mobile Device\FlashFX Disk\Startup\ADSCopy
3. Copy the remaining 46 unzipped files into
 \Mobile Device\FlashFX Disk\Startup\ADSCopy\CSCO

NetOp Host

1. UnZip the archive NetOpHv8.zip in a temp directory on your PC.
2. Copy the file PPCopy_NTOP.inf to \Mobile Device\FlashFX Disk\Startup\ADSCopy
3. Copy the remaining 10 unzipped files into
 \Mobile Device\FlashFX Disk\Startup\ADSCopy\NTOP

Finishing

1. Disconnect the USB cable.
2. Power cycle restart the U/I
3. If the above procedure has worked, you should note PPCopy_CSCO.inf and PPCopy_NTOP.inf being executed along with other INF files. After Windows CE starts you should find icons for “netophostd” and “Aironet Client Utility” on the U/I desktop.
4. Insert a Cisco 350 card. You can use either the “Aironet Client Utility” or the Microsoft Zero Config Utility (by double clicking on the network icon in the system tray) to set wireless parameters such as infrastructure vs ad-hoc mode or entering any required WEP keys.
5. Double click “netophostd” to start the NetOp Host. This may ask for the Host license key to be entered each time the UniSpec is restarted. To avoid re-entering:
 - a. enter key once
 - b. exit the host application
 - c. use Start - Control Panel - ADS Persistent Registry applet; save the registry
 - d. when the NetOp Host is restarted it should no longer ask for the key

References:

- Cheng, Y., Gamon, J.A., Fuentes, D.A., Mao, Z., Sims, D.A., Qiu, H.-L., Claudio, H.C., Yang, W., Huete, A. (in press). A multi-scale analysis of dynamic optical signals in a Southern California chaparral ecosystem: a comparison of field, AVIRIS and MODIS data. *Remote Sensing of Environment*.
- Claudio, H.C., Cheng, Y., Fuentes, D.A., Gamon, J.A., Luo, H., Oechel, W., Qiu, H.-L. (in press) Monitoring drought effects on vegetation water content and fluxes in chaparral with the 970 nm water band index. *Remote Sensing of Environment*
- Fuentes, D.A., Gamon, J.A., Cheng, Y., Qiu, H.-L., Mao, Z., Sims, D.A., Rahman, A.F., Oechel, W., Luo, H. (in press) Mapping carbon and water vapor fluxes in a chaparral ecosystem using vegetation indices derived from AVIRIS. *Remote Sensing of Environment*.
- Gamon, J.A., Cheng, Y., Claudio, H.C., MacKinney L. Sims D. NDVI (in review) dynamics revealed by a mobile tram system for systematic sampling of ecosystem optical properties. *Remote Sensing of Environment*.

For further technical support, please contact us at:

PP Systems
110 Haverhill Road, Suite 301
Amesbury, MA 01913 U.S.A.

Tel: +1 978-834-0505
Fax: +1 978-834-0545

Email: sales@ppsystems.com
URL: www.ppsystems.com