LI-6800 Instrument Performance In Physiological Parameter Estimation

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Introduction:

The LI-6800 Portable Photosynthesis System introduces novel innovations in many respects—including a touch screen and intuitive interface, more precise gas analyzers, dynamic flow control, and rapid precise automated control of both CO_2 and H_2O.

- Gas Exchange systems are used to measure important leaf-level physiological parameters relevant to many disciplines.
- Some parameters are challenging to measure with commercial gas exchange systems due to system-level errors in measured parameters.
- Error sources include noise in the Infrared Gas Analyzers (IRGAs) and the CO_2 mixer used for controlling constant [CO_2] in the incoming air stream.
- Here, we compare 4 minutes of steady-state gas exchange measurements between the LI-6400XT and the new LI-6800 both with an empty fluorometer chamber and a chamber clamped onto sorghum (*Sorghum bicolor*) leaves in the dark (chamber LEDs off).
- Our main objective is to demonstrate reduced system noise in the LI-6800 portable photosynthesis system.

Empty Chambers

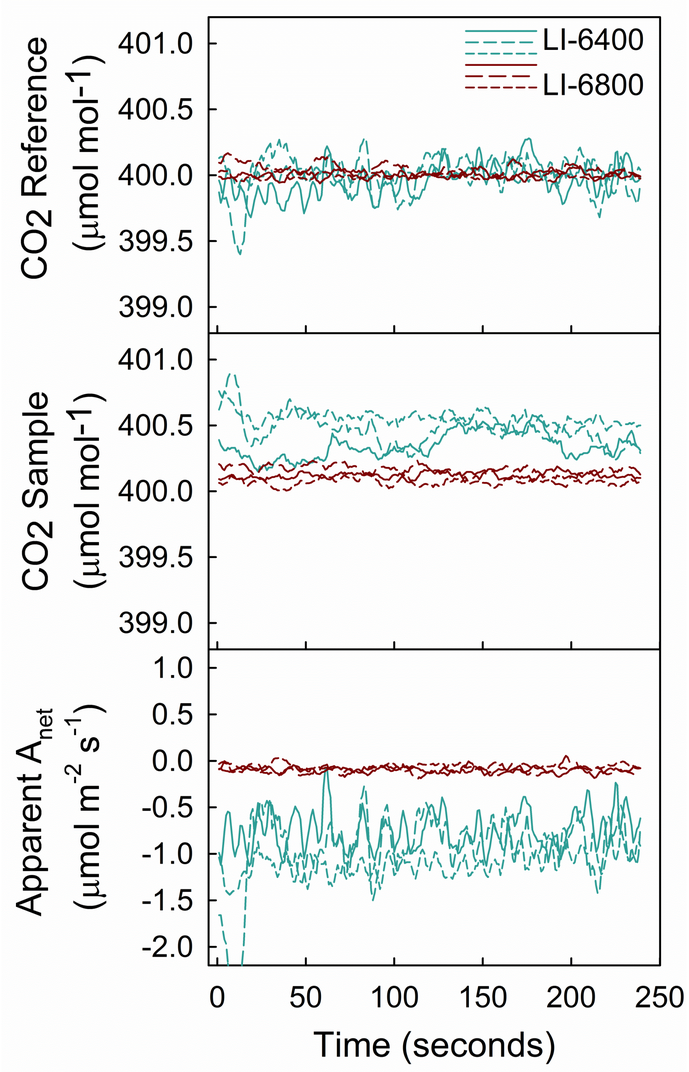

Figure 1: Reference CO_2, Sample CO_2 and calculated apparent net Assimilation.

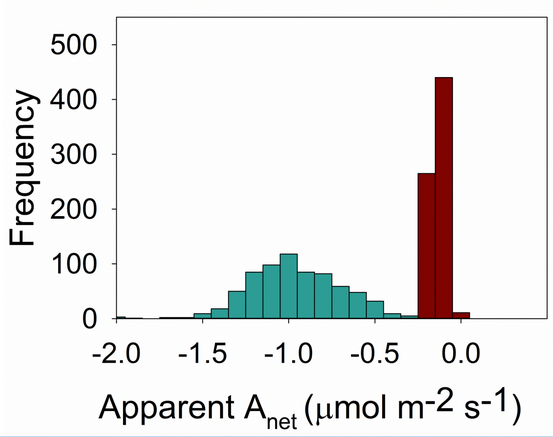

Figure 2: Histogram of apparent net Assimilation.

Chambers with Sorghum leaves

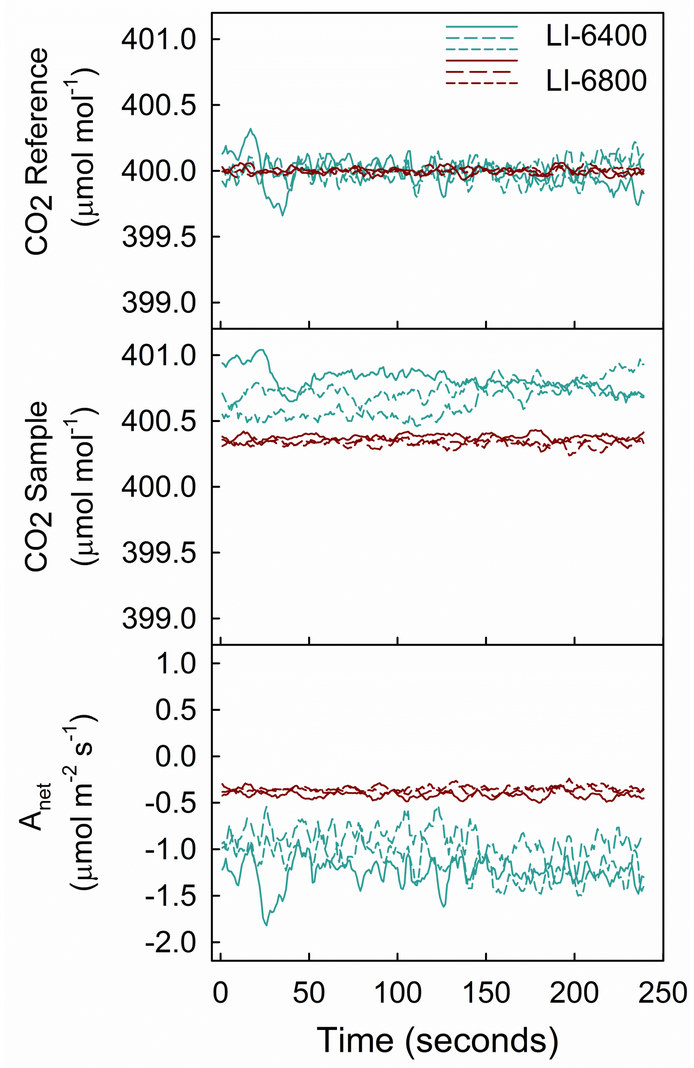

Figure 3: Reference CO_2, Sample CO_2 and calculated net Assimilation for sorghum leaves in the dark.

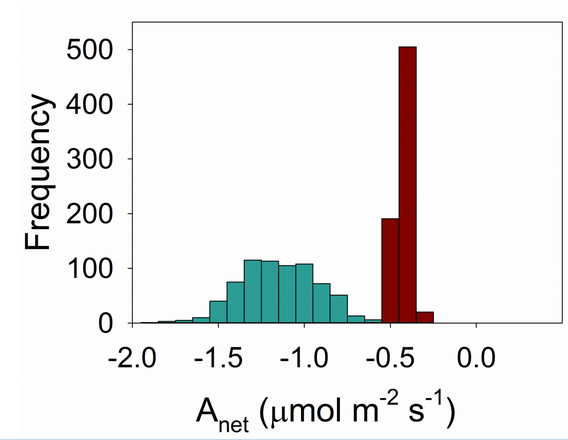

Figure 4: Histogram of net Assimilation.

Methods:

3 x LI-6400XT (with 6400-40 Fluorometer 2 cm^2 leaf area)
3 x LI-6800 (with 6800-01 Fluorometer 6 cm^2 leaf area)
Environmental Controls:

- Flow rate: 600 µmol s^{-1} (6800), 300 µmol s^{-1} (6400)
- CO_2 Reference: 400 µmol mol^{-1}
- Leaf Vapor Pressure Deficit: 1.5 kPa
- Leaf Temperature: 25°C
- Actinic light turned off in all cases

Ambient CO_2 in the laboratory was measured at ~1000 µmol mol^{-1} prior to and following the experiments

Data was recorded at ~ 1 Hz for 4 minutes. In case of sorghum leaves, all leaves were clamped for ~60 minutes prior to recording data

Conclusions:

- Data presented here demonstrates reduced system-level noise in the LI-6800 compared with the LI-6400XT.
- Improved performance is a combined result of reduced IRGA noise and noise from the CO_2 mixer.
- Measured respiration rates between 3 x LI-6800 on similar leaves provide more accurate and precise parameter estimation.
- Reduced noise in the LI-6800 will allow more precise estimation of other important physiological parameters.
- In addition to reduced noise, the LI-6800 data for CO_2 sample in the empty chamber is closer to the reference value. This result is consistent with a reduction in diffusion into the chamber, allowing reduced bias in parameter estimation.