

# FODTS Experiment: Ground Cover Variation

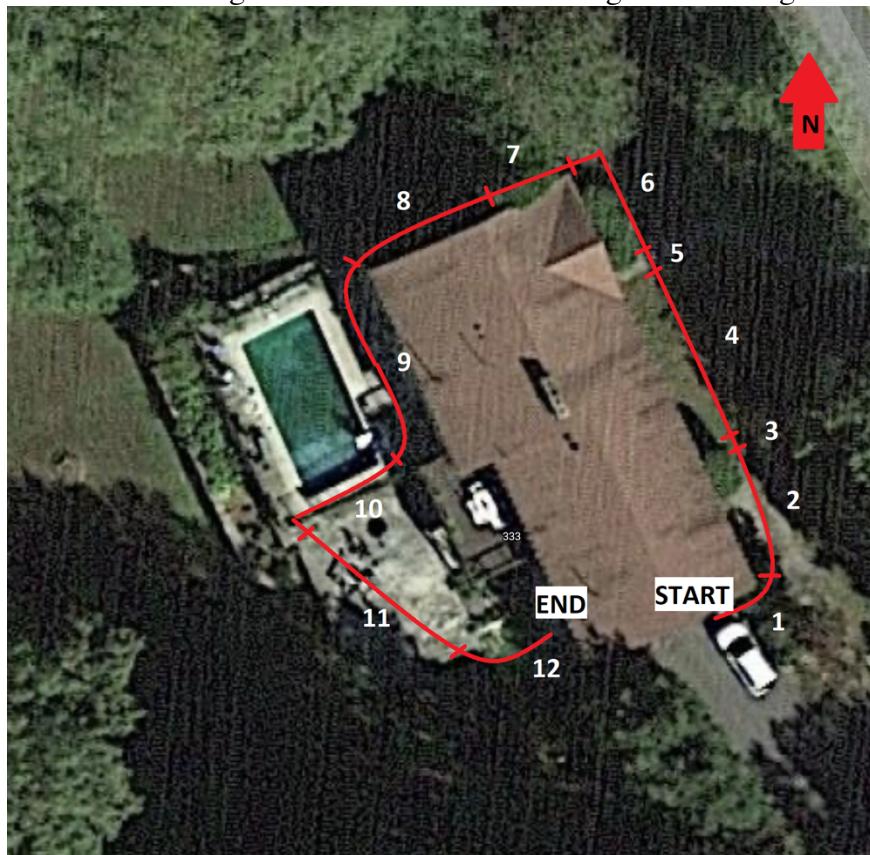
Home Experiment Series  
December 2<sup>nd</sup>, 2020  
Amherst MA

## Purpose:

The purpose of this experiment was to use the XT DTS system for environmental sensing with the limitations of an “at home” experiment. The fiber was placed across a variety of ground covers and left from approximately 1 pm December 2<sup>nd</sup> to 9 am December 3<sup>rd</sup> to observe how ground covers retain/change temperature through the course of a sunset and sun rise.

## Experimental Set-Up:

- Approximately 87 m of fiber was laid out surrounding a house in Western Massachusetts.
- The Approximate position of the fiber is shown below. Numbers in the figure correspond to the ground covers and lengths shown in the table and figure following that.



Number	Description	Approximate Lengths		Center Node
1	Driveway	3.27 – 6.37		4.845
2	Gravel	6.64 – 12.95		9.675
3	Pavement 1	13.25 – 15.0		14.505
4	Grass	15.0 – 25.4		20.606
5	Pavement 2	25.7 – 26.75		26.198
6	Leaves	26.9 – 34.1		30.519
7	Top Rocky Path	34.1 – 40.4		37.383
8	Bottom Rocky Path	40.4 – 48.55		44.5
9	Pool Area	48.85 – 60.26		54.414
10	Pool Floats	60.5 – 67.1		63.819
11	Patio	67.1 – 77.8		72.462
12	Back Grass	78.1 – 86.7		82.376

1	2	3	4	5
Driveway	Gravel	Pvmt1	Grass	Pvmt2

6	7	8	9	10	11	12
Leaves	Top Path	Bottom Path	Pool	P. Wght	Patio	Back Grass

- Ground cover lengths were measured by placing the fiber at the boundary in a small bowl of ice water. The resulting troughs were measured by the XT DTS system. If the trough occurred at a single point, the corresponding measurement was selected as the boundary for both related sections. If the trough was reflected in by two nodes (because the ice bowl was somewhere between the two), the boundary for each section was selected to be the corresponding of the two nodes. Ice measurement XT DTS data can be found in this folder as well.
- Fiber was not laid across the driveway to avoid damage from traffic, and interference from dogs.
- XT DTS system was set up in garage as shown in figure below with fiber leading out the left hand side of the garage



- Fiber was plugged into XT DTS system Channel 1.
- XT DTS system set to start sampling at approximately 1 pm December 2<sup>nd</sup>.
- XT DTS system sampling terminated at approximately 9 am December 3<sup>rd</sup>.

#### **XT Client Configuration:**

- Units: Metric
- **Time zone not set – Default: UTC 00:00 – (5 hr difference than actual time)**
- Fiber length set to 2 km
- Zero reference set to 1m
- Sampling Interval: 0.25 m; Measurement Length: 87 m; Acquisition time 180s
- Probe 1 selected
- Differential loss correction: Fixed Value: 0.25 [ dB/km ]
- Temperature offset correction: External Probe
- Measurement mode: Continuous

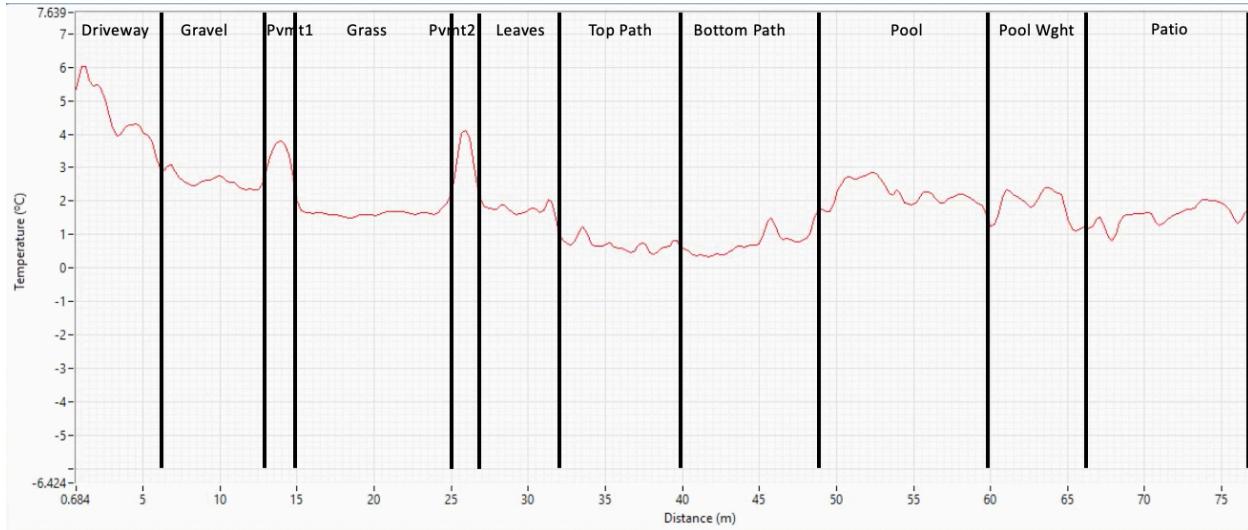
#### **Experiment Notes:**

- December 2<sup>nd</sup> was totally overcast. Scattered flurries were observed throughout the day and over night while sampling was occurring.
  - No snow observed to remain in the morning
- December 3<sup>rd</sup> was a cloudless day
- Sun Rises over the horizon at approximately sections 1,2 first

- Sun sets over the horizon at approximately section 11.
- Pool weights section of fiber was place in and out of small puddles along its length.

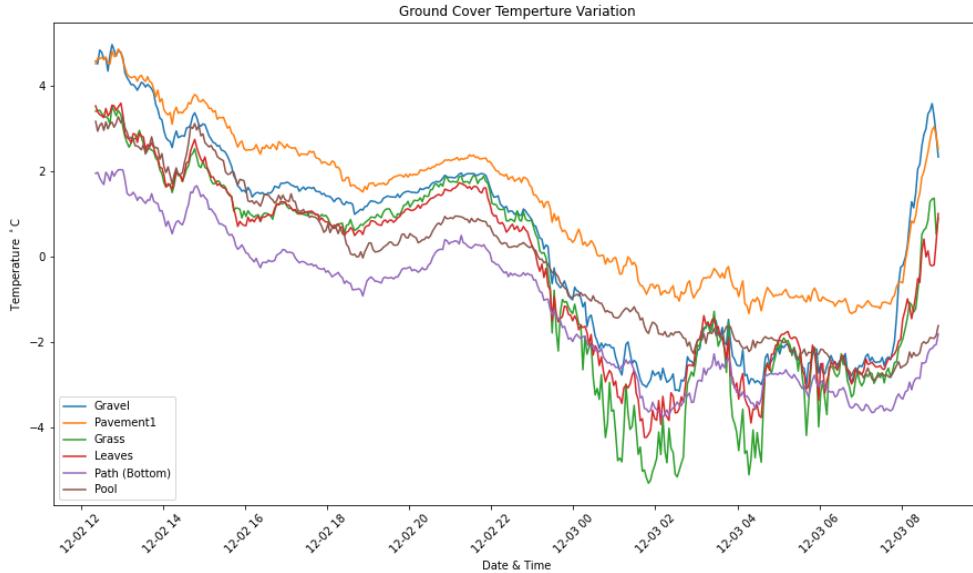
## Results Notes:

- Results show clear and consistent differences between ground cover types (see figure below). Temperature was observed to be great on more dense substances—Pavement & Driveway (also more resistant to temperature changes), than substrates where the fiber was less flush with the ground –Grass & Leaves.



- A video displaying the full time series of data can be found in this folder.
- .ipynb script ‘Node Timeseries’ contains an example of how to pull and visualize selected nodes over the time series of data. Example shown below: selected ground cover center nodes plotted over time.

- Notebook also corrects time zone error



- Little impact of the sun's movement on December 2<sup>nd</sup> was detected in the results, likely due to the overcast sky.
- Strong impact of the sun's rise on December 3<sup>rd</sup> is observed. And as expected, impacts the fiber in order of zones that it comes in contact with first: Gravel – Pavement 1 – Grass – Leaves.
  - Pool and Path (Bottom) which are shaded from the sun rise are least impacted.
- Errors:
  - Fiber potentially moved slightly in some zones over the course of the measurement – no significant movement was observed.
  - When retrieving the fiber, many bends with exposed cladding. Believed to be a result of the fiber spinning up upon itself.
    - No break in the fiber was observed physically or in the data. DTS fiber check also reported no break.
    - Noted that for future use of this type of fiber, it likely needs to be deployed under some quantity of tension.

