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# Using solar panels to deduce weather

Kasper Lynderup - 20105319

Timothi Hansen - 201303516

Rohde Fischer - 20052356

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Advisor: Niels Olof Bouvin



AARHUS  
UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE

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## 1 Introduction

Photovoltaic modules (PV), commonly known as solar panels, works by having two silicon based semiconductors, namely a n-type and a p-type. The two semiconductors react when exposed to photons which is used to create electricity [Nea12].

It has already been found that weather data to is relevant for PV generating systems, when maximum power point tracking is used to maximize the power output, mainly temperature and radiation [MOI04].

**►Based on this we want to try to correlate power generated with cloud conditions◄**

## 2 Related work

There has already been some research in measuring weather data by utilizing some of the sensor capabilities that arises from the increasing amount of technology in use.

OpenSignal have created the app WeatherSignal that utilized phone battery temperatures [ORL<sup>+</sup>13] to deduce information about the air temperature in heavily populated areas. They proved a strong relation between the temperature of a the phone batteries and the outside temperatures. The authors believe that the data can be further improved, if the data can be calibrated according to phone models and if the phone is inside or outside, as heating and air conditions bias the data.

A correlation between the radio signals used for phones and rain measurements has also been proved [LUS07]. The radio signals can be used to measure the amount of rain in between two points. The measurements is fairly accurate, and it's assumed that they can be further improved if improved for the signal loss due to wet antennas.

It is believe that the combination of various weather sensing techniques such as [LUS07], [ORL<sup>+</sup>13] and measurement of clouds by PV systems, such as proposed in this article, is likely to have some useful potential. For instance the maximum power point tracking units of PV systems can be improved with weather data [MOI04].

### 3 Data analysis

The expected data is to see a clear connection between the output of a PV and clouds[SCS<sup>+</sup>14]. The aparant view of things the data also seem to have a correlation as can be seen on figure 1. It seems likely from the graph that there is some correlation, between the clouds and the PV system, as there's a tendency for the effect to drop when there's more clouds.



Figure 1: Cloud cover and averages of power generated (10 minute intervals)

However further analysis puts some doubt to that. The blue line in figure 1 shows the optimal effect measured at a given point of time in the day. To test that hypothesis a scatter plot comparing how far from the optimal the power generation is compared to the cloud coverage.



Figure 2: Scatter plot from comparing effect, cloud coverage and optimal effect

#### ►Boxplot comments, more analysis◄

Having a larger area of PV systems can smooth out noise in the data [SCS<sup>+</sup>14] and it is thus likely that having an area with more panels would even out the data in meaningful way. Since we're still interested in the cloud coverage, it would still have to be local areas, such as a small village or similar.

### 4 Acknowledgments

►Lynderup senior - dad, Bouvin - computer scientist, supervisor, Karl Fischer - chemist◄

## 5 Conclusion

►...◄

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