# Experimental investigation of an infrared de-icing system for wind power application in cold climate

**WinterWind 2020**

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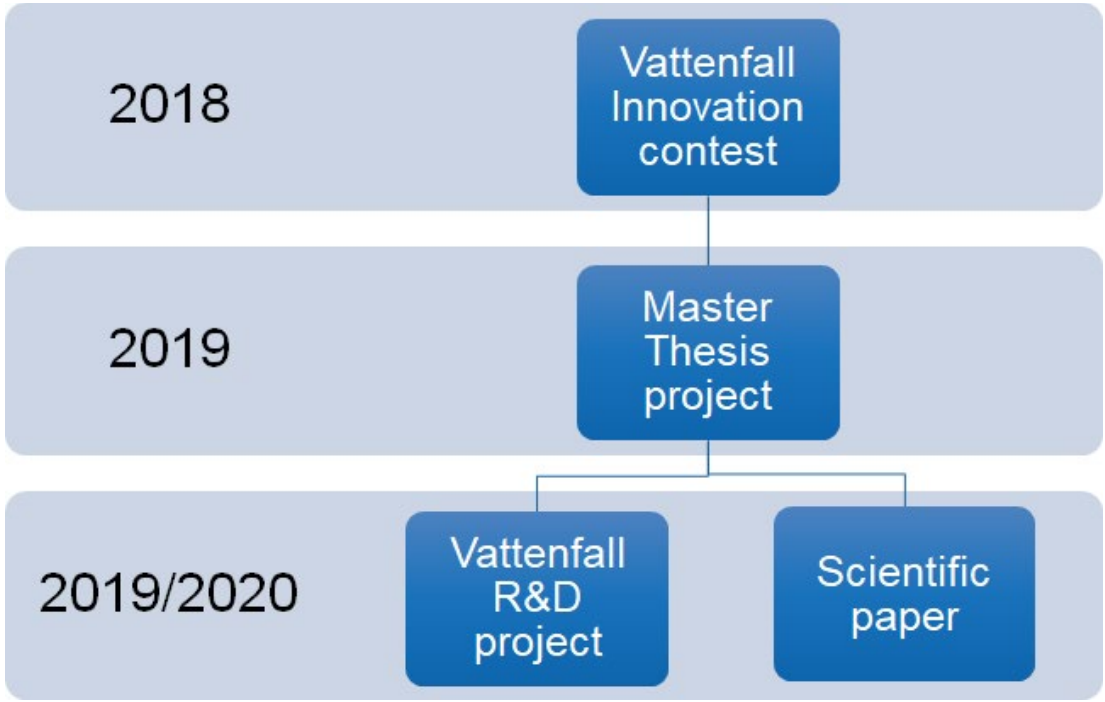
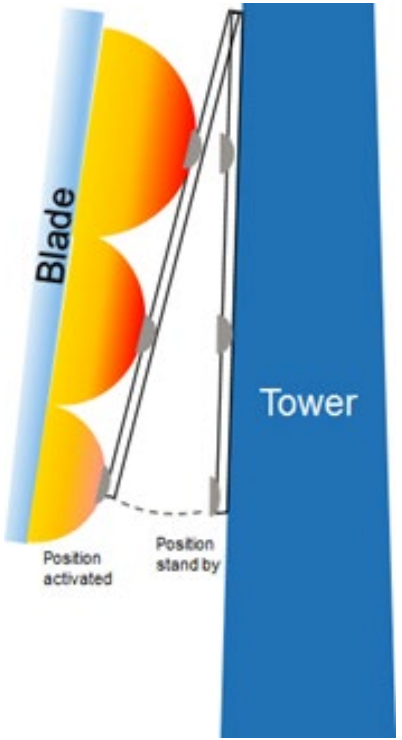
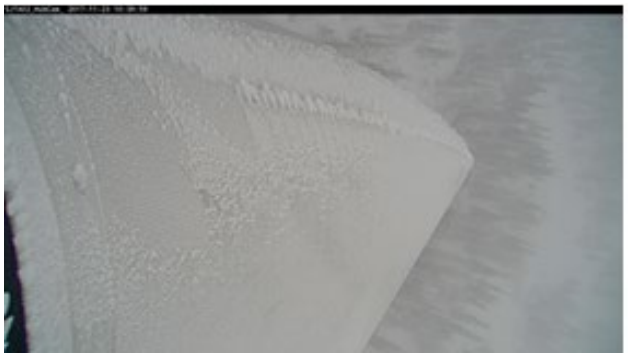
# Background


2018
Vattenfall Innovation contest
2019
Master Thesis project
2019/2020
Vattenfall R&D project
Scientific paper

# Infrared de-icing system



# Why research on a new de-icing system?



# Setup and experiments

# Setup and indoor testing facility

# Setup and indoor testing facility

| | **Indoor testing facility** |
|---|---|
| Location | Piteå, Arctic Falls |
| Area | 10 000 $m^2$ |
| Ambient temperature | -8 °C |
| Humidity | High |
| Snow machines | TechnoAlpin AG<br>500 litre/hour, 3kW |

# Setup and indoor testing facility

| | **Equipment** |
|---|---|
| Thermal camera | Testo 875i, -30 °C to +100 °C |
| Load cell | Anyload, 5 to 300 kg |
| Analog input module | National Instruments, NI-9219 |

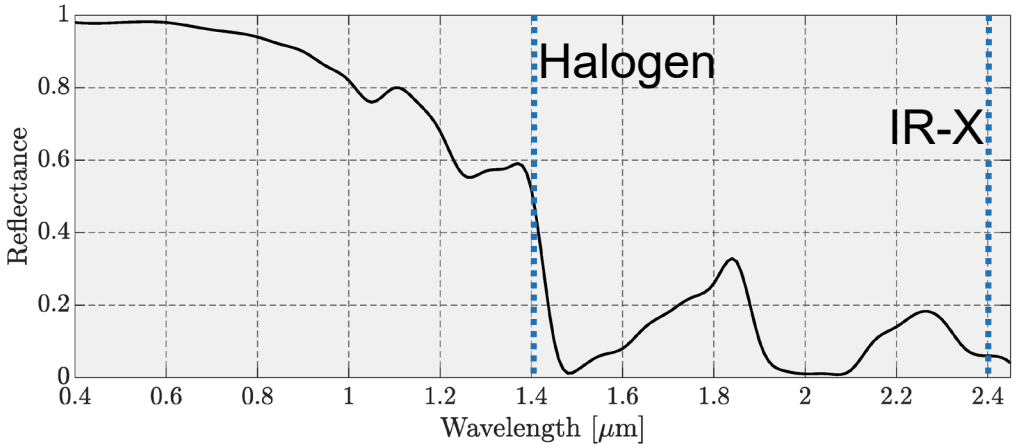
# Infrared heaters

| | **Halogen** | **IR-X** |
|---|---|---|
| Manufacture | Opranic | Opranic |
| Filament material | Tungsten | NiCr |
| Filament temperature | 2 000 °C | 1 000 °C |
| Wavelength peak | 1.4 µm | 2.4 µm |
| Input power | 2.6 kW | 2.6 kW |

Halogen

IR-X

# Infrared heaters




Reference: Nolin AW, Dozier J. A hyperspectral method for remotely sensing the grain size of snow. Remote Sensing of Environment 200;74:207-216.

Halogen

IR-X

# Blade section

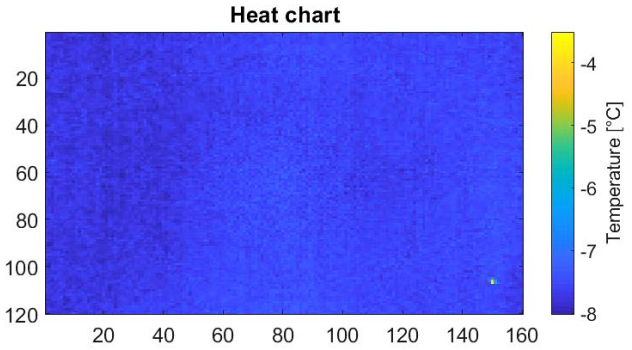
| | Blade section |
|---|---|
| Size | 2 x 1.2 m |
| Weight | 87 kg |
| Material | Fibre glass |
| Coating | Mankiewicz's gel coat |
| Origin | Offshore wind farm in Denmark |

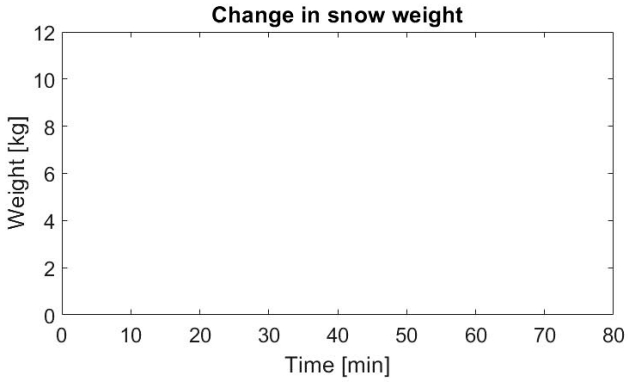
# Rime ice

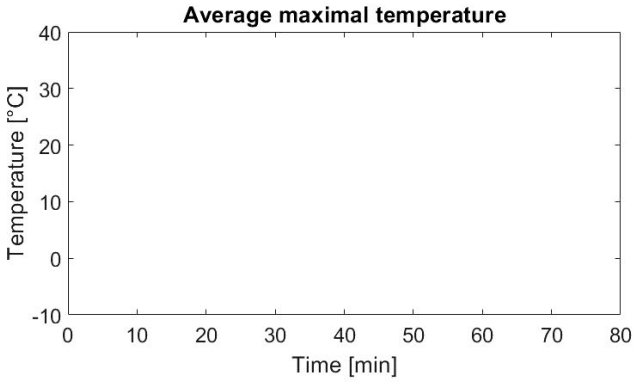
## Simulated soft rime ice

## Iced wind turbine blade

# Experimental results



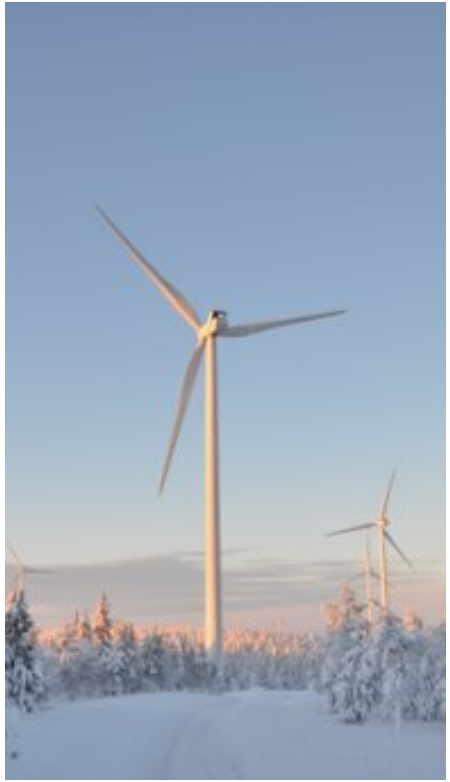



# Conclusions and future work

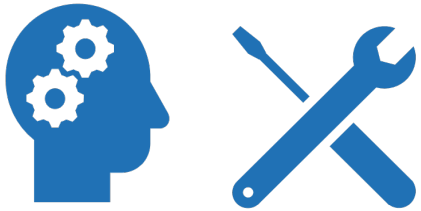
# Future work

- Scientific paper, LTU
- Ongoing research project at Vattenfall
  - New special designed infra heaters from Opranic
  - Outdoor testing in windy conditions
  - Increased distance between heater and blade, 3 m
  - Faster de-icing
- Tests on a real wind turbine



# Challenges and implementation

- Installation and maintenance
  - Need of de-icing of the de-icing system
- Work environment and environmental questions
- Be competitive or even better than existing de-icing systems
- Significant cheaper
- Integrated with existing control system
- Oscillating blades
- Overheating blade
- Affecting the bird life




To be continued...