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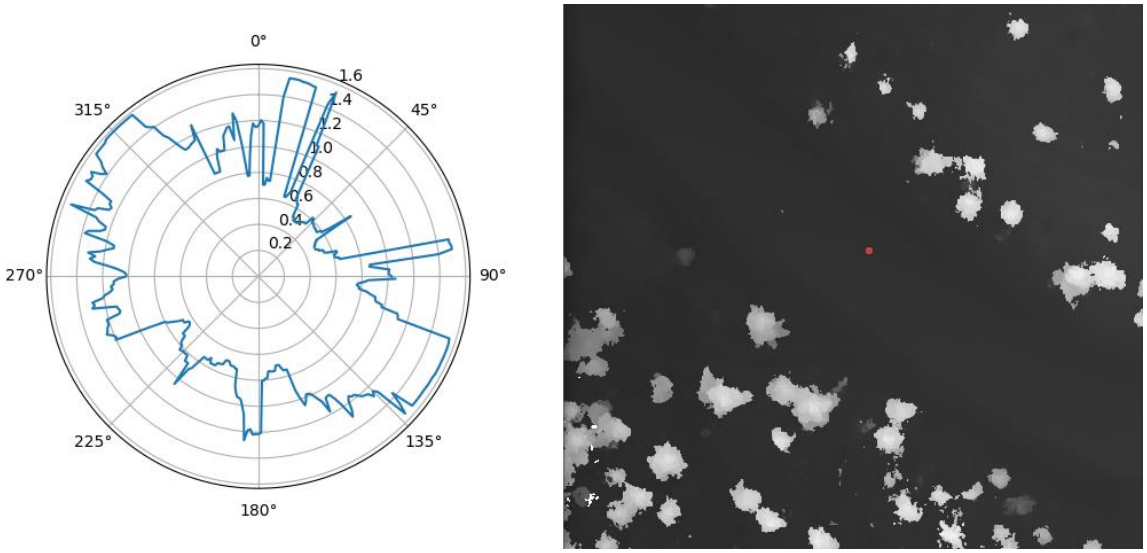
Sky view factors and local horizon angles on the Sodankylä 5G test track

Road weather information and forecasts are important for autonomous vehicles. With accurate weather and road condition data, they can adapt their driving speed and select the safest route. Local geographical features and the road surroundings can have a considerable effect to the road surface temperature. For example, dense canopies block solar radiation and cause temperature in the forest to be colder than in the open field during sunny days. When temperature is near zero degrees, some parts of the road network can be frozen while others are not. Usually, the local features are not considered in the road weather forecasts as the FMI road weather model excepts open surroundings. However, the road weather model has been modified to take the road surroundings into account. This is accomplished by implementing sky view factors and local horizon angles into the model. Sky view factor describes the part of the sky that is visible at the road point and varies between 0 and 1. Local horizon angle describes the angle of the visible horizon in certain direction. These parameters were determined for several road points at the Sodankylä airport test track by using digital elevation model (DEM). DEM is a raster data format where grid values describe height. In addition to geographical features, DEM includes vegetation and trees. The DEM was generated from drone images with Agisoft software. The local horizon angles were determined in each direction with degree increments. The sky view factors and local horizon angles are used in the road weather model to modify the incoming radiation. If the sun elevation angle is lower than the local horizon angle in the direction of the sun, the sun is behind obstacle and the direct solar radiation is set to zero. Sky view factor reduces the amount of incoming diffuse solar and thermal radiation from the open sky. The amount of radiation affects the heat balance at the road surface and thus has a great effect to the road surface temperature. The model using sky view factors and local horizon angles is currently in test use and produces road weather forecasts for 32 road points along the test track.



Small part of DEM from the test track (on the right) and local horizon angles at the red point (on the left)