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Diplomarbeitspräsentation

Radial Diagrams for the Visual Analysis of Wind Energy Production Data

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Motivation

The application background motivating this work is the **need for better visualizations in the energy sector** to address common challenges within the special field of wind energy production. In the process of energy production, more and more data is produced and recorded every year. This data is usually worthless without further exploration, analysis, and presentation.

The aim of this work is to **improve and/or facilitate real tasks of real users based on real data** in the context of this application domain. Ultimately, this work shall save analysts time and hence companies resources and money.

Problem Characterization

Wind and gust data typically contains **directional information**. Such directional data is often poorly visualized or mishandled by common data analysis software. Due to the underlying nature of this data, it is intrinsically a **circular data type**.

Circular data inherits a natural coherence, i.e., a **real-world relationship** or correlation between values, from its data source. The data is **circularly closed** as the concept of an origin, a start or an end, is usually arbitrary or undefined.

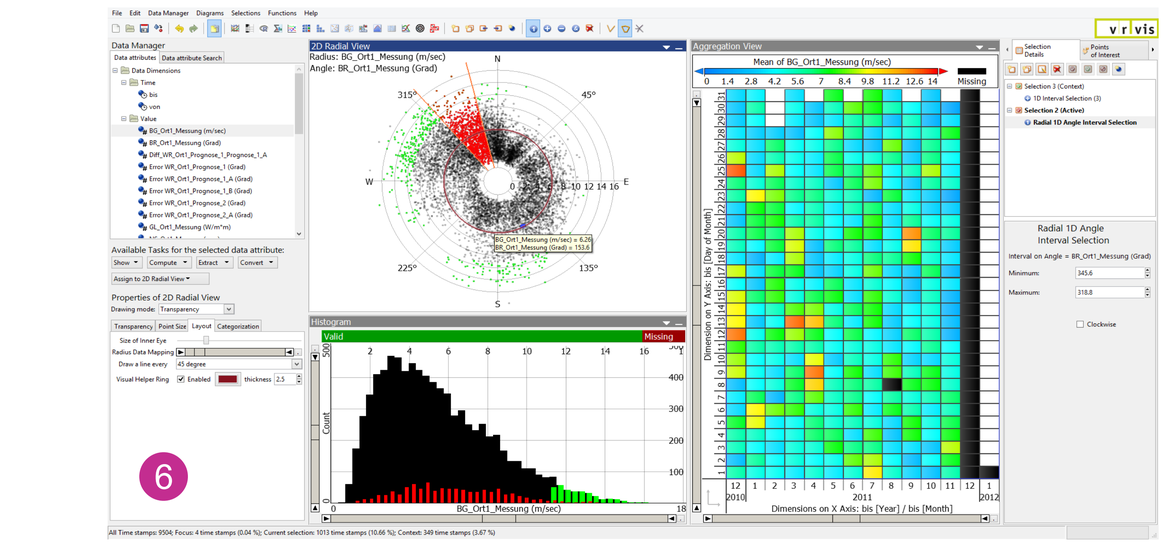
Using traditional non-radial methods for a visual analysis is problematic as **circular data requires specially designed approaches** if the task is to analyze and/or present circular information.

Solution

This work proposes a set of **techniques for the visualization and interaction with circular data in radial diagrams**.

The diagrams operate in the polar coordinate system and thus are well suited to **solve the problems of maintaining the natural coherence and circular closure** of circular data. The proposed techniques provide data analysts with a more intuitive way to visually analyze circular data such as data that contains wind directions.

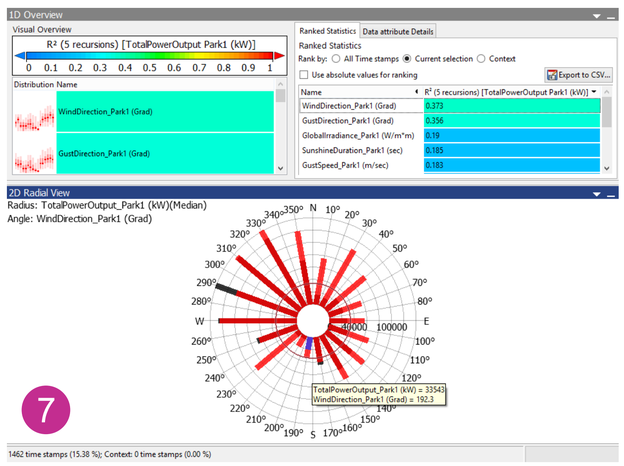
The proposed diagrams include a **Radial Scatter Plot** 1, a **Radial Bar Plot** 2, a **Radial Line Plot** 3, a **Radial Box Plot** 4, and a **Radial Divergence Plot** 5. These diagrams are integrated into an advanced **visual analysis software framework** 6 by extending it with a novel view, i.e., the 2D Radial View.



Evaluation

The proposed techniques were **evaluated in a case study**. The case study was based on two large real-world data sets, which originated from a national energy company.

A domain expert executed common tasks such as identifying dominating wind directions 3, exploring total power output influences 7, and evaluating weather prognosis data 5.



A **performance data set** with 105000 records per data dimension was used to test the implemented visualization and interaction techniques' applicability to large numbers of records.

Results

The novel techniques provided data analysts with **valuable insight** into their data.

The results indicate an **improved work flow** of common tasks and a **successful system integration**.

The reported deployment at a national power grid operator further demonstrates the system's **user acceptance and importance**.

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