International Cartographic Association
Association Cartographique Internationale

Human interactive sequences caused by the desert fog

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Keywords: human-computer interaction, human behavior, desert fog, graph

Abstract:

When users zooming or panning on multi-scale interactive map, even considering the effects of spatial acuity and direction sense, disorientation slows their cognitive ability to recognise their current position. The frequent lack of informational cues to aid their continued search is called the "desert fog" phenomenon (Jul and Furnas, 1998). To investigate the desert fog effect, it is important to understand how the human behavior interactive with map during this interactive process. Different aspects of the desert fog have been studied in the past, including (1) a theoretical model of disorientation and desert fog (Touya et al., 2023); (2) a user survey to measure the lag due to disorientation during the use of a map(Touya and Berli, 2023); (3) the development of tools to precisely track map users interactive sequences. The purpose of this research is to use 3D human interaction graph sequences to figure out user's behavior when they are trapped in the desert fog.

Creating a graph from the sequences of interactions with the map

A 3D graph is a good way to visualize the sequences of user-map interaction. As shown in Figure 1, each new position of the map view is recorded as a 3D node (X coordinate of the map center, Y coordinate of the map center, zoom level). On each node, we also record the following features: (1) angle between the previous, current and next node, (2) distance from the previous/next map view center, (3) duration of the visualization of the map view.

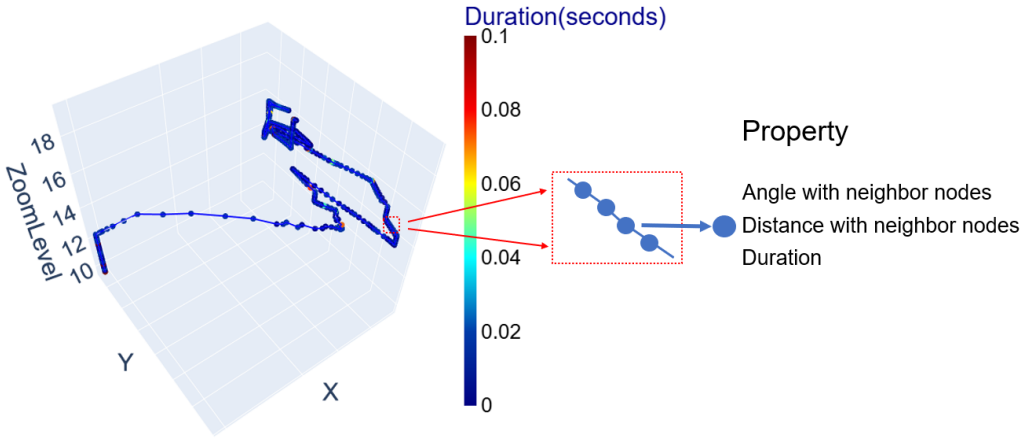


Figure 1. Interactive sequence graph

Interactive sequences caused by desert fog

From the observation of user-map's interaction, when their behavior facing desert fog on the map, ignoring the influence of the rotation experiment in psychology, we define a topology of specific interaction sequences to illustrate it, normally occurred in the interval of zoomlevel 12 to 16:

Type 1: Zoom in-Pan-Zoom out. The user knows their target approximate location, from the reading of a small scale view. Then, they zoom in to visualize it at a larger scale. However, along with zoom-in, the target becomes out of view. So, the user intends to search it by panning, but the target location remains unclear without clear visual cue. Finally, the user zooms out to find new cues about the precise location of the target.

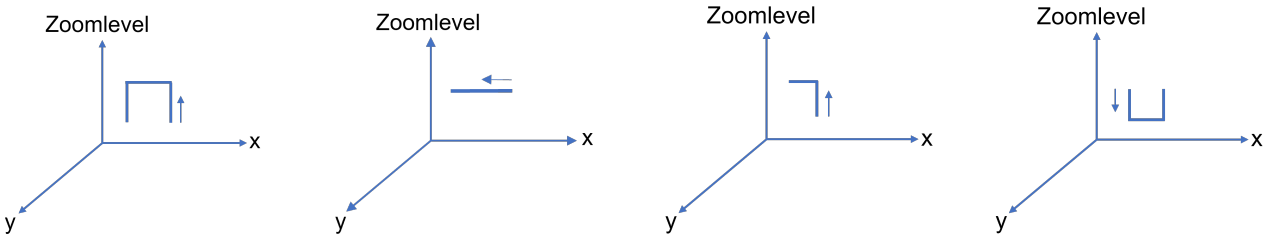
Type 2: One-Direction Panning. The user knows the target's approximate direction, but they use the panning interaction which is not so accurate. When the pan becomes too long in distance and duration, it means that the user passed by their target without seeing clearly in the map view, and is disoriented about their current location.

Abstracts of the International Cartographic Association, 10, 173, 2025
32nd International Cartographic Conference (ICC 2025), 17–22 August 2025, Vancouver, Canada.
https://doi.org/10.5194/ica-abs-10-173-2025

Type 3: Zoom in-panning. When the user sees something interesting in the map at medium/small scale and wants to see it at a larger scale, they zoom in, but this interaction is not very precise, particularly when achieved with hand gestures on a touch-screen. Then, the target might not be visible at the large scale and the disoriented user might pan in different directions to find it.

Type 4: zoom out-panning-zoom in. When the user does not find their target in the current map view, and is disorientated, they can zoom out, pan a little, and then zoom in to their target. But this sequence of interactions can also be just a simple way to reach a new target (zoom out-pan-zoom in is often much quicker than just panning).

Type 5: Quick zoom in-zoom out. In a similar fashion as type 3, when a user zooms in, as the zoom might not be well centered, they might be disoriented by the map appearing at a large scale. In this case, the disorientation causes a quick zoom-out after the zoom-in, to further try a more precise zoom-in.

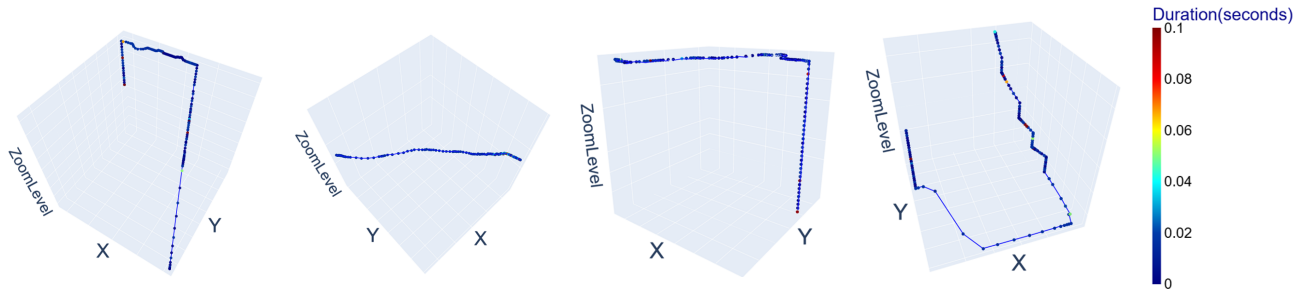


(a) Type 1 (b) Type 2 (c) Type 3 (d) Type 4

Figure 2. Four of the five types of interaction sequences caused by desert fog

Segmenting the graphs with the typical interaction sequences

(Figure 3) shows the same four typical interaction sequences extracted from graphs built from real uses of a web interactive map, collected in a user survey.



(a) Type 1 (b) Type 2 (c) Type 3 (d) Type 4

Figure 3. Human behavior of four types

There are many remaining questions to use these typical interaction sequences to detect desert fog from the interactions of the user. First, we need to precisely segment the graph to distinguish the sequences due to desert fog that are not related to disorientation. Then, we need to be sure those sequences really correspond to a user's disorientation experience, and a user survey will be design necessary, with maybe the use of an eye-tracker or the sensor able to detect emotion from the user.

Acknowledgements

This research has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 101003012).

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