SPATIOTEMPORAL ANALYSIS IN VIRTUAL ENVIRONMENTS USING EIGENBEHAVIORS

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MY PREVIOUS WORK

- The characteristics of visitor styles are the proximity distance to the nearest item as well as the observing time.
  - For example, one visiting style spends quite a long time to observe all exhibits by walking closer to exhibits but avoids empty spaces, but another style prefers to move and stop empty space but avoid areas near exhibits.

Today, the visualization of eigenbehaviors representing the principal behaviors of users in virtual environments is presented.

EIGENBEHAVIOR

Following MIT Media Lab Reality Mining Group,

- Mobile telephones, company ID badges, and similar common devices form a sensor network which can be used to map human activity, and especially human interactions.
- Complex Social Systems: "By continually logging and time-stamping information about a user's activity, location, and proximity to other users, the dynamics of large-scale human behavior can be measured. "

http://reality.media.mit.edu/

EIGENBEHAVIOR

- It can determine the primary behaviors of players' movements by extracting their repeating structures.
- The repeating and common structures are identifiable movement directions of users in the same virtual space.
- In other words, the users' movements are dominated by a set of primary structures.

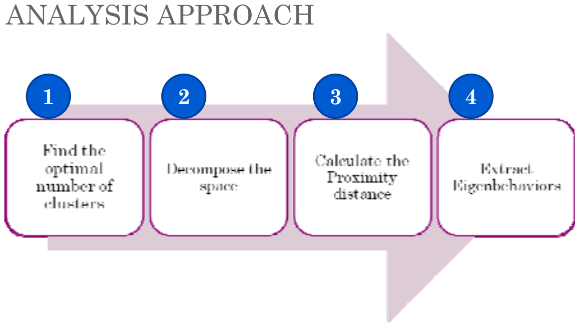
AIM AND SCOPE

- Develop a systematic analysis approach for discovering the primary users' behaviors.

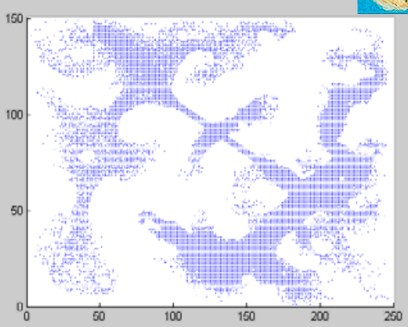
A Use Case:
- Apply to real players' movement obtained from Angel Love Online (ALO)

Results:
- Visualization of the movement pattern and directions versus the time session
- The corresponding implications

ANALYSIS APPROACH



MAP OF THE TARGET SPACE



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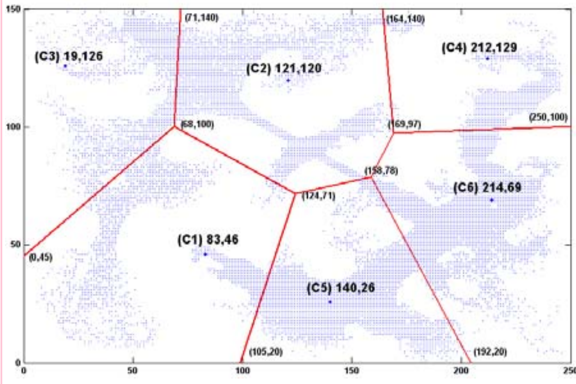
OPTIMAL NUMBER OF CLUSTERS



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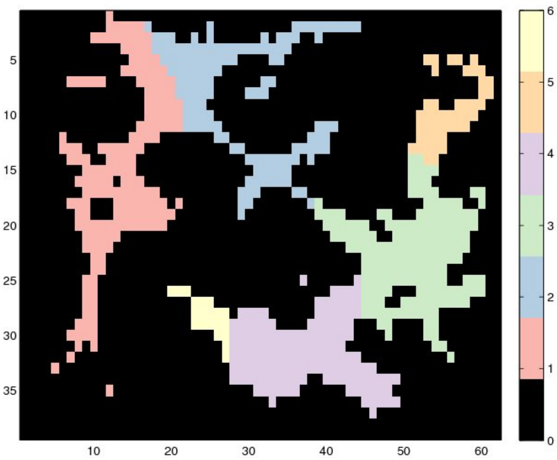

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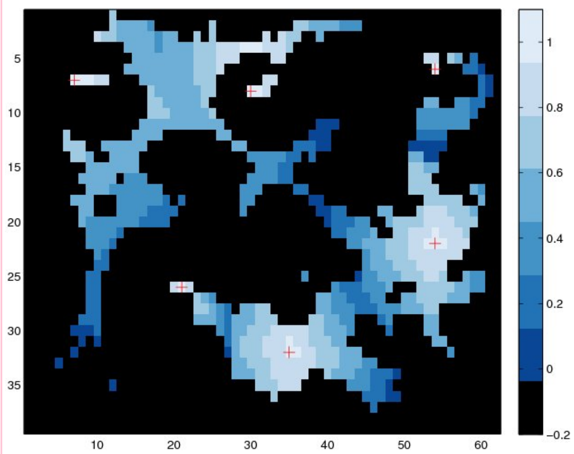

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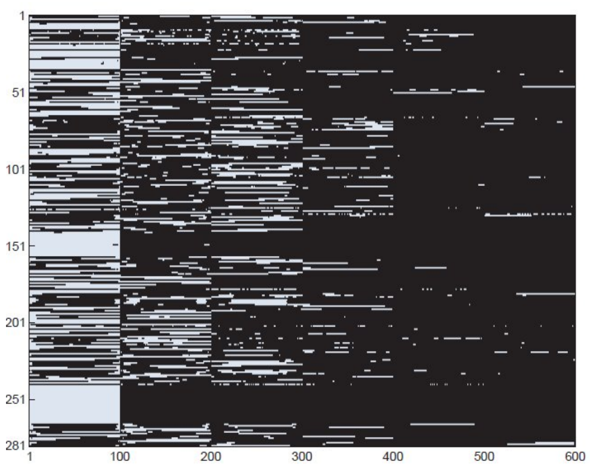
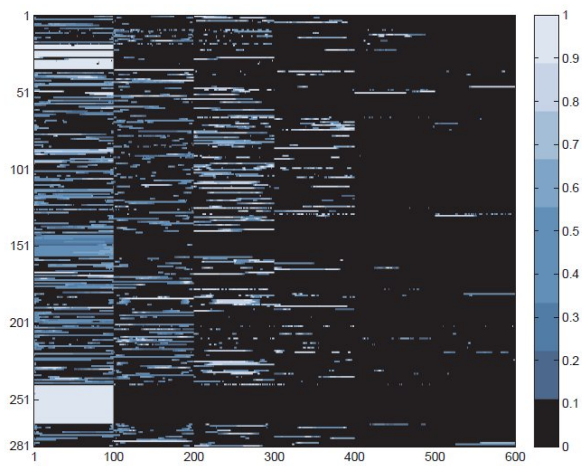
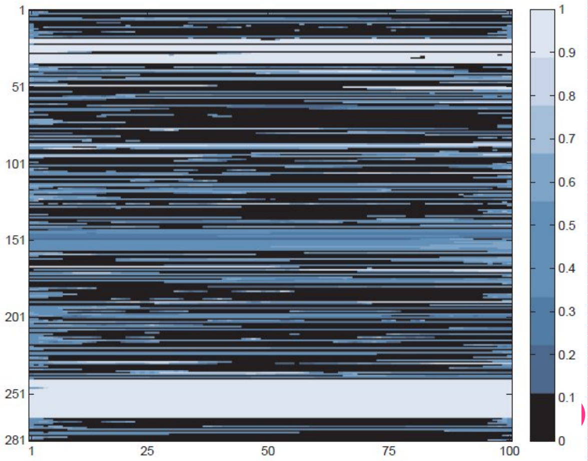




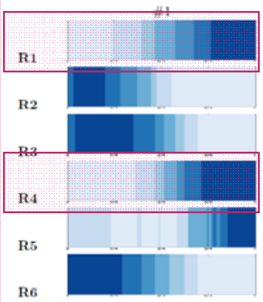


A USE CASE: ANGEL LOVE ONLINE (ALO)GAME

- To analyze the movement direction of players, we filter out the sessions whose average velocity is nearly zero.
- In the data set, there are 169 unique players but 122 valid players with 2,231 total sessions after the filtering.

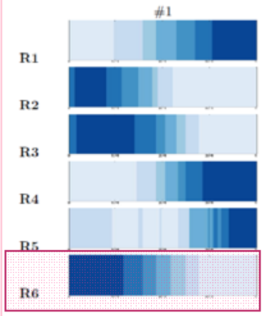
Descriptive statistics per player	Mean	SD
Number of sessions	13.20	27.01
Average length of sessions	309.70	561.85
Average distance of sessions	181.39	442.11
Average velocity of sessions	4.78	22.11

RESULTS AND THEIR IMPLICATIONS



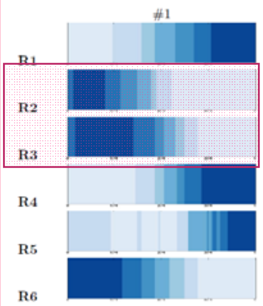
1.For **the first primary behaviors** on R1 and R4, players move away from the center. Players in R4 start moving out from their first positions later than the other.

RESULTS AND THEIR IMPLICATIONS



2. For **the first primary behavior** on R6, players heading is towards the center.

RESULTS AND THEIR IMPLICATIONS



3. For **the first primary behaviors** on R2 and R3, players do not start from the farthest area at the beginning; however, their movement direction is towards the center.

APPLICATIONS

- The eigenbehaviors of players of each region can be used for boosting the effectiveness of the network quality in the virtual space.
- The network quality affects a player's decision to leave a game premature; therefore, predicting whether a player will still be online at a given instant can improve system design, in terms of server processing scheduling, dejitter buffer dimensioning, and the choice of transport protocols.

CONCLUSION

- I presented a case study where we applied our proposed analysis approach to the ALO data set.
- The approach was the 4-steps procedure for finding the eigenbehaviors.
- By using the approach, we decomposed the ALO island into six regions and then computed the eigenbehaviors where movement behaviors in each region can be visualized.
- Interpretation of those behaviors was conducted based on the results and a priori knowledge of the map context.