The work of the Distributed Interactive Applications Group at NUI Maynooth

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1. What is a DIA?

A **Distributed Interactive Application** (DIA) is a software system in which **multiple users** interact with each other over a **network** in real time

Examples : Massively Multiplayer Online Games, Collaborative Editing Software, First Person Shooters

Users within a DIA experience a shared sense of

Space

Time

Presence

2. Problems

Latency - Time taken to transmit a packet

Jitter – Variation in latency

Unreliability – Proportion of lost or corrupted data

Bandwidth - The maximum amount of information that can be transmitted along a channel

3. The Effects

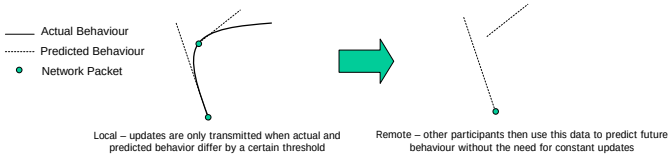
- Users appear in different positions, performing different actions

- Interaction is difficult
- Controls feel sluggish
- Participants peforming actions at different times
- Updates received long after the occur, or not at all

- Users don't feel like they are sharing the same world with other users.
- Users are well aware that they are in a virtual world. Feeling of immersion is lost.

4. Background

- The Distributed Interactive Applications Group formed in 2003.
- Currently has 8 members.
- The Torque Games Engine is employed as a research tool.
- The key focus of the group to date has been the examination of the impact of network limitations on the performance of DIAs. In particular, much attention has been given to the analysis and improvement of predictive techniques
- Goal of predictive techniques : reduce the amount of transmitted data without affecting consistency. Consistency is the degree to which remote views of the same scene match.
- A popular exampe is dead reckoning [1]. Dead reckoning works as follows :



Local – updates are only transmitted when actual and predicted behavior differ by a certain threshold

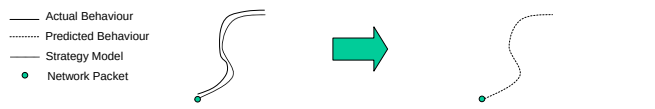
Remote – other participants then use this data to predict future behaviour without the need for constant updates

- The rest of this poster describes the key contributions made by the DIA group in this area.

5. Predictive Techniques

Hybrid Strategy Model (HSM)

- User behaviour within a DIA can follow preset patterns. This fact can be exploited to reduce packet transmission rates in the Hybrid Strategy Model approach.
- Under the HSM approach, multiple models of user behaviour are constantly monitored. The model which gives the best prediction performance is chosen as the predictive model [2].
- An example of this is the Spatial HSM [3]. Under this approach, both dead reckoning and the long term strategy model approaches are employed. The long term strategy model approach works as follows:



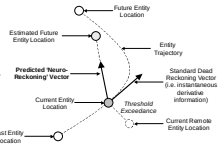
Local – An update is transmitted detailing which long term strategy model the actual behaviour is following

Remote – The same long term strategy model is used to predict future behaviour.

- Depending on the behaviour of the entity, either the long term strategy model or dead reckoning is used to predict future entity behaviour. Shown to reduce packet transmission rates in comparison to dead reckoning alone.

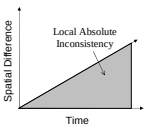
Neuro-reckoning

- Dead reckoning updates traditionally contain instantaneous entity dynamics information [4].
- Does not necessarily provide the best prediction information.
- Neuro-reckoning uses Neural Networks to choose prediction information better suited to actual entity behaviour.
- Shown to reduce packet requirements



Neuro-reckoning in action

Time-Space Threshold



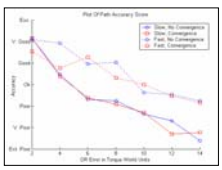
Absolute Inconsistency Measure

- Dead reckoning thresholds are usually based on spatial inconsistency.This approach can result in an inefficient use of network resources.
- The time-space threshold takes both spatial inconsistency as well as the length of time the spatial inconsistency has lasted into account in determining when to transmit an update [5].

6. Pyschoperceptual Measures

- Psycho-Perception measures the change in user experience to sensory stimuli, such as eye movements and linguistic feedback.
- Used to determine what a person playing a game can perceive and what they find tolerable.
- Eye Data indicates that a person makes a decision up to 600ms before implementing their actions in an FPS game.
- Could be used to pre-send information through the network [6].

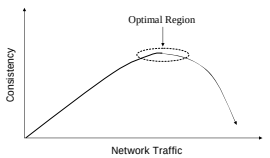
Eye tracking experiment in action



Linguistic feedback for path accuracy with different velocities and error thresholds

- Linguistic feedback indicates HSM gives greater perceptual results than Dead Reckoning.
- It also highlights pacing as being an important factor in the acceptability of error thresholds.
- Future work will use perceptual information to develop intuitive error thresholds.

7. Effects on Consistency

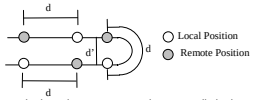


There exists an optimal point at which underlying capacity is efficiently utilised

- Most work aims to reduce the amount of network traffic transmitted.
- No consideration is given to how this actually impacts on overall consistency.
- Less packets does not necessarily equate to improved performance
- Reducing packet transmission levels below a certain level will lead to inefficient use of available resources, resulting in unnecessary inconsistencies

Other aims of this work:

- Provide a clear definition of consistency, and an analysis of the factors of consistency.
- Examine how different network traffic reduction schemes contribute to maintenance of these factors of consistency.
- Provide a new measure of consistency that takes all of these factors into account.



Current standard consistency measures have some limitations

8. References

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[2] McCoy, A., S. C. McLoone, D. Delaney and T. Ward "Formalizing a framework for dynamic hybrid stategy models in distributed interactive applications" (2006) *Proc. IET Irish Signals and Systems Conference, Dublin, Ireland, June 28-30, 2006, pp. 357-362.*

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[5] Marshall, D., Roberts, D., Delaney, D., McLoone, S.C. and Ward, T. "Dealing with the Effect of Path Curvature on Consistency of Dead Reckoned Paths in Networked Virtual Environments" (2006) I*EEE Virtual Reality Conference (VR2006), Alexandria, VIRGINIA, USA, 25-29 March, pp. 299-300*

[6] Kenny , A., S. C. McLoone, T. Ward and D. Delaney "Using user perception to determine suitable error thresholds for dead reckoning in distributed interactive applications" (2006) P*roc. IET Irish Signals and Systems Conference, Dublin, Ireland, June 28-30, 2006, pp. 49-54.*