Specifying Consistency Requirements for Massively Multi-User Virtual Environments
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Problem: MMVE Consistency

• Balance of consistency and responsiveness important
  • consistent view for all MMVE users
  • reflect actions instantaneously in the user’s view

  ➔ This balance is highly situation-dependent

Interaction Context

• Update Type
  • The specific action the update represents
  • E.g., Position Update or Trade

• Affected Entities
  • The entities affected by the update, e.g. avatars or objects being involved in the interaction
  • Entities initiating interaction and those affected by the effects of the interaction

• Dependent Interactions
  • Update’s dependence of and influences on other interactions than its own
  • Existing interactions as well as potential future interaction

Future Work

• Detection of the Interaction Context at runtime
• Integration of the concepts into our existing consistency management framework
• Evaluation of our concepts

Approach: Consistency Metrics

• Inconsistency Tolerance
  • Minimal requirements for each state update in terms of the maximum state divergence tolerated
  • E.g., distance between an entities’ actual and perceived position

• Interactivity
  • Update’s requirements regarding responsiveness, i.e. how much latency can be tolerated
  • Maximum amount of time until the state change appears to the user

• Priority
  • Possible relaxation of the consistency requirements, in case of high system load
  • Determine for which updates the provided consistency can be reduced first

Specification Examples

To use our specification scheme, an application developer has to

i. identify the set of Interaction Contexts relevant to its application
ii. Specify the consistency and responsiveness requirements using the Consistency Metrics

<table>
<thead>
<tr>
<th>Context</th>
<th>Update Type</th>
<th>Affected Entities</th>
<th>Dependencies</th>
<th>Incons. Tolerance</th>
<th>Interactivity</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context 1</td>
<td>Position Update</td>
<td>Avatar A</td>
<td>none</td>
<td>high</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Context 2</td>
<td>Position Update</td>
<td>Avatar A &amp; B</td>
<td>none</td>
<td>medium</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>Context 3</td>
<td>Position Update</td>
<td>Avatar A &amp; B</td>
<td>yes</td>
<td>low</td>
<td>high</td>
<td>medium</td>
</tr>
</tbody>
</table>

Peers@Play-Project: www.peers-at-play.org