Augmented Reality Smartphone Compasses: Opportunity or Oxymoron?

Conference or Workshop Item

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Augmented Reality Smartphone Compasses: Opportunity or Oxymoron?  
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So, which way IS North?

The Issue
- Smartphone and tablet Compasses use magnetometers to sense direction
- Like any compass, a magnetometer measures only the local magnetic field inside the device
- Which is subject to magnetic influences (errors)
- The error for a calibrated device varies with the orientation of the device
- A deviation curve shows the errors against heading, typically combining a linear offset with sinusoidal components

The Experiment
12 markers were placed around the edge of a field. At the centre of the field is a stool. Participants sit on the stool and use a smartphone compass to measure the direction to each marker in turn.

17 participants, each with a different device, completed the task 4 times

The Implications
- Deviation errors in the compass used to sense smartphone orientation will mean that AR markers may be positioned incorrectly
- This is usually avoided by registration of the image against (known) object maps
- Almost by definition, people will use AR navigation apps in unfamiliar territory
- If registration is not possible, e.g., in open country or on the sea, markers will be unreliable
- Users need to understand the Apps' limitations
- Consider the following mock-up of an AR screen

Markers A and B are separated by less than 9°
B and C are about 6° apart
Only one points to a landmark essential to avoid submerged rocks—but which one?

The Results
- The large graph below combines the deviation curves for all 17 devices
- "Heading" is the orientation of the device
- The data for each device is shown beside its graph
- "offset" - linear error
- "amp" - amplitude of deviation curve
- "rmse" - root mean square error after recentering to correct offset

Summary
- All tested devices display a significant deviation curve
- Maximum mean error (offset + amplitude) from 6 to 10 degrees
- Uncalibrated errors are typically much larger
- Calibration appears not to persist
- Different Apps on a device may suffer different deviation curves
- This must impact on the degree to which they can be trusted.