SpatialVision: Bringing Popping-Out RViz to Life with AirPods

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Search and Rescue robots
[Okada+, IROS2010]

Bridge inspection drones
[Mizutani+, IROS2013]

Tracked vehicle simulation
[Okada+, ICRA2020]

Overlaid fiducial markers
[Okada+, ICRA2021]
Today’s topic: Stereoscopic system **SpatialVision**
Stereoscopic System (SS) is useful

Surgical robots often employ SS [Nam+, 2012]

SS expedited UGV's movement through tight spaces [Chen+, 2010]

SS reduced collision with surroundings [Luo+, 2021]

Would also be useful in design
But SS can be bulky & costly

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<tr>
<th>Head tracking</th>
<th>Projectors</th>
<th>LC shutter gl. + disp.</th>
<th>Polarized gl. + disp.</th>
<th>Lenticular display</th>
<th>HMD</th>
<th>Standard display</th>
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<td>Face track camera</td>
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SpatialVision aims **low complexity & cost**
Hardware: AirPods + iPhone + PC

AirPods tracks head with built-in IMU

iPhone forwards head pose to PC

PC (RViz) aligns Rviz’s camera angle with head pose

Feels 3D due to the motion parallax
Built-in IMU
(AirPods Pro Gen 2, etc. originally for spatial audio)

Access to AirPods IMU via API (Core Motion. iOS14 or later)

Camera pose binding to a Tf frame
(FrameAligned mode)

What if iOS app that streams AirPods IMU to Tf?
AirSense:
App streaming iPhone & AirPods sensors to ROS

- iOS15 or later
- ROS1/2
  (requires rosbridge)
- AirPods IMU
- iPhone IMU
- Face track
  by front cam

- Useful as
  a standalone app
  (MagSafe attachable IMU
  that can stream
  via WiFi or mobile)
Tf handles pose between PC & user

- **Known** (iPhone IMU)
- **Known** (fixed)
- **Unknown** (Offset of IMUs)
- **Unknown** (Mount offset of AirPods)
- **Unknown** (AirPods IMU)
Calibrate “Unknown”s in 10 seconds

- Estimate unknown offsets by matching head track with the iPhone’s front cam
- No camera required once calibrated → works out of FOV or in a public place
- ROS1 Noetic or ROS2 Humble
SpatialVision finally works!
Stars / Issues / PRs are welcome!

- Code will be committed once a paper has been published

[yoshito-okada/AirSense](https://github.com/yoshito-okada/AirSense)

[yoshito-okada/spatial_vision](https://github.com/yoshito-okada/spatial_vision)
ユーザとRVizの視点をTfで同期
ユーザとRVizの視点をTfで同期