Extensive characterization and modeling of bicycle-to-bicycle link quality

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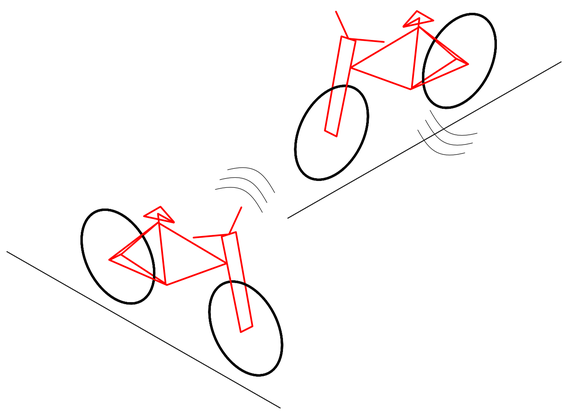
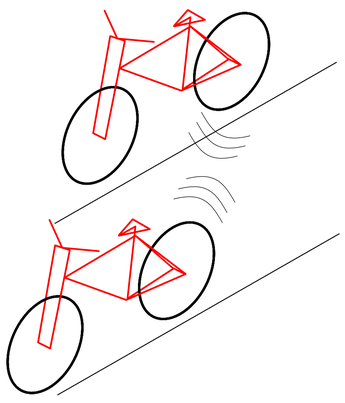
Overview

Vision – Bicycles communicating with other bicycles

Devices/things are getting increasingly inter-connected. Bicycles are no exception. Wireless on bicycles allows users on the street to communicate with other bikers. Whether they are:
1) unknown users passing by



or 2) known bikers moving in platoon formation.



Problem

[**WANT**] Allow audio communication/announcements between commuters, and for recreational/performance purposes within a platoon/group of athletes – mainly applications based on VoIP.
[**HOW**] Exchange data with no need for infrastructure:

- Cellular is expensive and too power-hungry.
- Neighboring WiFi access points are to unreliable/unstable due to mobility.

[**GOAL**] We intend to create a reliable ad-hoc network – communicate directly between devices.

System Challenges

To build such network, we need to characterize the communication link between two bicycles. These vary dramatically under different:

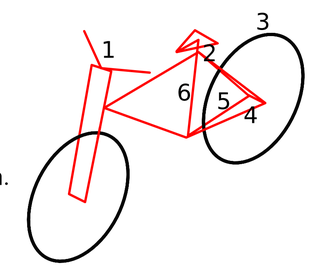
- **Relative orientation**
- **Antenna placement**
- **Bike material**
- Distance

Results - Radiation pattern of a bicycle.

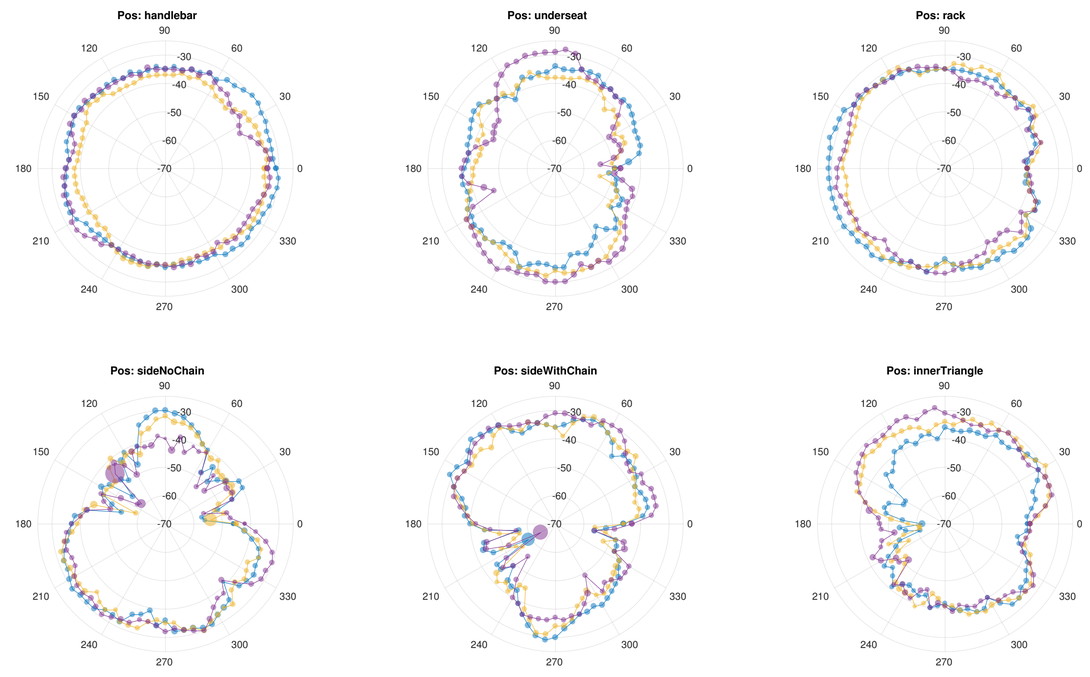
Methodoloy

Location: anechoic chamber.

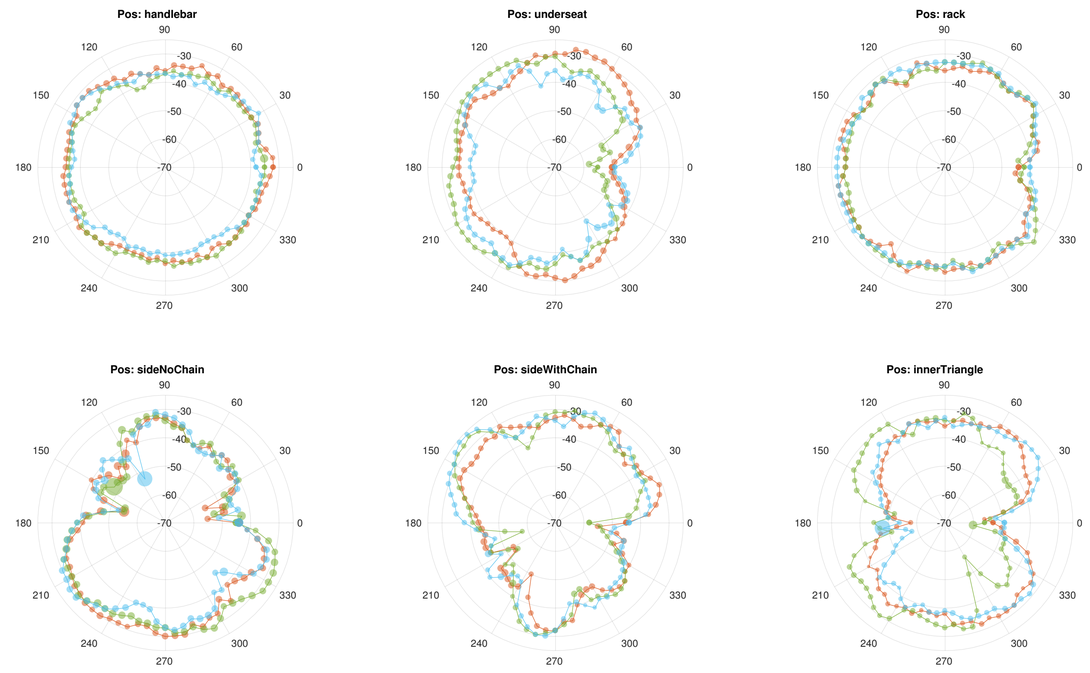
- A) Install NIC+antennas in six locations:
- B) Rotate six bikes 360º over their middle axis
- C) Measure beacon's RSSI transmitted by an antenna at 4.5m.



Aluminum bicycles



Iron bicycles



Final remarks

☑ Handle-bar and back-rack are the most isotropic locations.
☑ These also have the highest average RSSI.
☑ The radiation patterns for a given antenna position are quite similar among different bikes.
☑ The difference between iron and aluminum is mostly visible at the inner-triangle position.

Future work

☐ Develop a model based on the collected data.
☐ Model will allow simulating the link performance under different bike trajectories.
☐ We will measure throughput and PDR given RSSI to further extend the model.

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