Analysis of the Headway Distance from a Subset of SHRP2

Dr. Andrej IVANCO

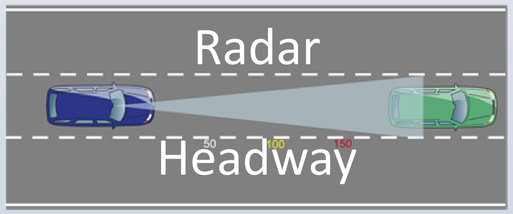
Research Assistant Professor, Department of Automotive Engineering, Clemson University, Greenville, SC

INTRODUCTION

- Autonomous vehicles are at the verge of adoption
- Adoption rate depends on transparency to the end user

OBJECTIVES

- Analyze SHRP2 data and identify the naturalistic driving behavior
  - Case one - headway distance



DATA SOURCE

- Radar data from ~3,800 trips analyzed from SHRP2
- Trip duration of 17-24 minutes to assure consistent spectrum of road conditions
- Overall about 20 timestamped data channels from:
  - Radar:
    - Range headway and lateral
    - Left and right lane distance
  - Gyroscope
    - Accelerations and angular velocities
  - Vehicle network
    - Vehicle speed

METHOD

- Radar captures objects within 200m ahead and ±40m laterally

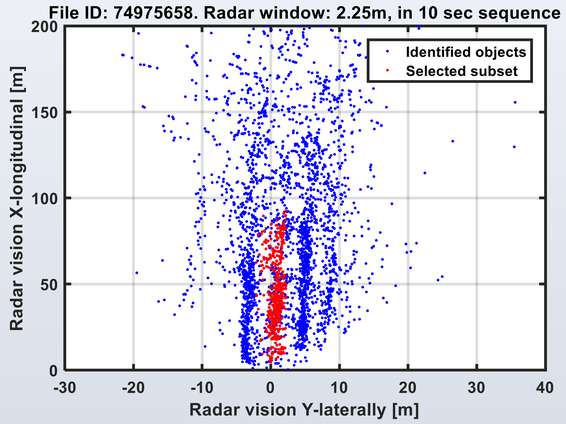


Figure 1: Radar data example

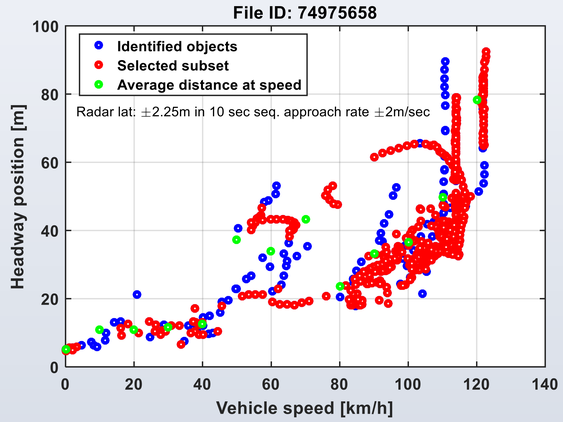


Figure 2: Speed vs. Headway distance

- Data filtration use to identify steady targets that:
  - Are within 2.25 m laterally, assuming that the standard lane width is 4.5 m (15 ft.).
  - Consecutive record of the object for at least 10 seconds to avoid “ghost target” records.
  - Headway gap change <2 m/s (<5 mph) to be considered as steady state car following.

RESULTS

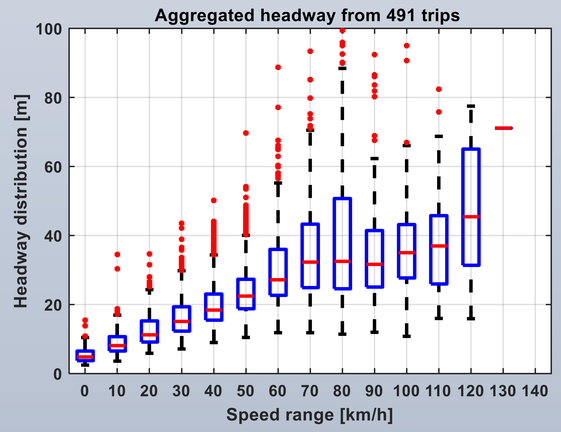


Figure 3: Aggregated headway

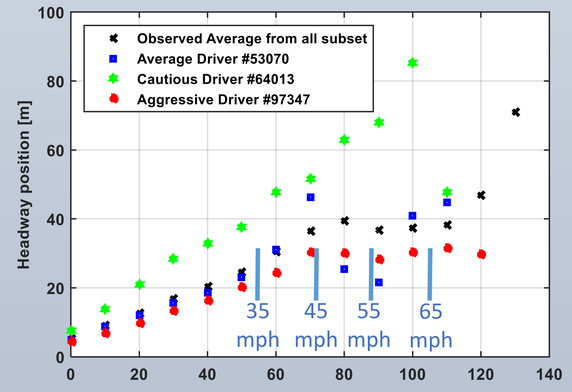


Figure 4: Vehicle specific headway

- Clear relation between driving speed and headway
  - At low speeds to <70 km/h nearly linear
  - At higher speeds >80 km/h average headway flattens to 40m

CONCLUSION

- Headway distance can be a signature for the driving style
- Tree distinct driving behavior identified
  - Cautious
  - Average
  - Aggressive
- Open topics, influence of:
  - Traffic Conditions
  - Driving environment, city vs rural
  - Driving situation, off-ramp, merging, etc.

REFERENCES

- Schoettle, B. and M. Sivak, Motorists' Preferences for Different Levels of Vehicle Automation. 2016, The University of Michigan Sustainable Worldwide Transportation.
- Sullivan, J.M., M.J. Flannagan, A.K. Pradhan, and S. Bao, Literature Review of Behavioral Adaptation to Advanced Driver Assistance Systems. 2016.
- Lu, J., D. Filev, and F. Tseng, Real-time Determination of Driver's Driving Behavior during Car Following. SAE Int. J. Passeng. Cars – Electron. Electr. Syst., 2015. 8(2): p. 371-378.
- Nakayama, A., M. Fukui, M. Kikuchi, K. Hasebe, K. Nishinari, Y. Sugiyama, S.-i. Tadaki, and S. Yukawa, Metastability in the formation of an experimental traffic jam. New Journal of Physics, 2009. 11(8).
- Gorman, T., L. Stowe, and J. Hankey, S31: NDS Data Dissemination Activities , Task 1.6: Radar Post-Processing. 2015.

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