Lecture 8
(Handouts)
Ramp Metering
RAMP METERING
WHY RAMP METERING

- Safety (Breakup Platoon Traffic)
- Maintain Freeway Operations ✓
FREEWAY FLOW

1-min Moving Average

Flow, vph

0 20 40 60 80 100 120 140 160

Speed, km/hr

0 20 40 60 80 100 120 140 160

Time

5:00 6:00 7:00 8:00 9:00 10:00
RAMP METERING CLASSIFICATIONS

By Operations Level
- Local
  - Fixed Time
  - Traffic Responsive
- System Wide
  - Coordinated Freeway Ramp Metering
  - Integrated Freeway/Surface Arterial Ramp Metering

By Geometry
- Single Lane (w/o HOV)
- Multiple Lane (w/o HOV)

By Location
- Entrance Ramp
- Freeway Connector
- Mainline Metering

By Operations Rule
- Single Metering - One Vehicle per Green
- Bulk Metering - > 1 Vehicle per Green
TRAFFIC-RESPONSIVE RAMP METERING

- Mainline Upstream Detectors
- Mainline Downstream Detectors
- Demand Detector
- Merge Detector
- Warning Sign/Signal
- Metering Signal
- Advanced Queue Detector
- Frontage Road
ALINEA Algorithm

- Local traffic responsive
- Based on feedback control theory

\[ M_r(t) = M_r(t-1) + K_R[\pi_m - \pi(t)] \]
COORDINATED FREEWAY RAMP METERING
COORDINATED RAMP METERING SYSTEMS IN THE U.S.

- Seattle: 126
- Portland: 110
- LA: 1478
- Phoenix: 122
- Salt Lake City: 23
- Denver: 46
- Minn-Sa: Paul: 430
- Milwaukee: 127
- Chicago: 117
- New York: 75
- N. Virginia: 26

- Implemented
- In Progress
COORDINATED RAMP METERING ALGORITHMS

- **BOTTLENECK** Algorithm - Seattle, WA
- **ZONE** Algorithm - Twin Cities, MN
- **HELPER** Algorithm - Denver, CO
- **SWARM** Algorithm - Irvine, CA