A Magnetically Coupled Inductive Loop Sensing System for Less-lane Disciplined Traffic

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Intelligent Transportation System
Homogeneous and Heterogeneous Traffic
Traffic Detector

- Detect various vehicles reliably
- Categorize as bus, car, motor cycle, bicycle, etc.
- Count
- Measure the speed of the vehicle
- Direction of movement
- Keep the power dissipation low

Heterogeneous
Traffic Flow Sensors

In-roadway Sensors

- *Tape switch*- US 4568937, US 4472706

- *Inductive Loop Detectors* - US4472706, US3571789

Over-roadway Sensors

- *Video Image*- US 7646890, US5535314

- *Microwave radar*- US5266954, US7439876
Existing Inductive Loop Detector

suitable only for lane disciplined and homogeneous traffic

Inductive loops are placed inside a Saw cut made in the road
The Proposed Inductive Loop Detector
Magnetically Coupled Inductive loops

Mutually coupled inductive loop detector with the multiple inner loop (1, 2, … n) and a single outer loop. All the inner loops are identical and a pictorial view of the loop employed is shown right side.
Electrical equivalent circuit

Magnetically-coupled inductive loop system
The Measurement Scheme Employed for the Magnetically Coupled Inductive Loops

\[ v_{arb} = v_m(\sin 2\pi f_{p1}t + \sin 2\pi f_{p2}t + \ldots + \sin 2\pi f_{pn}t). \]
Experimental Setup and Results

- **Single Outer loop**
- **Multiple Inner loops**
- **Inductive Loops Switched with the carpet**
- **Measurement System**
Experimental Setup and Results

- Single Outer loop
- Multiple Inner loops

Observations:
- Vehicle classification and count
- Monitoring system setup
- Measurement system setup

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Results of the Sensitivity and Resonance Frequency shift Test

The parallel resonance \textbf{frequency shift} in the presence of a conductive/metallic object
Results from the Mutually Coupled Multiple Loop Detector

Signature of a bus obtained from multi-loop vehicle detector
Results from the Mutually Coupled Multiple Loop Detector

Signature of a car obtained from multi-loop vehicle detector
Results from the Mutually Coupled Multiple Loop Detector

![Diagram showing voltage vs time for Loop 1, Loop 2, and Loop 3 with signatures for Motorbike, Bicycle, and Scooter.]

Signature obtained from all the three loops when there was continuous movement of vehicles.
Results from the Mutually Coupled Multiple Loop Detector with Outer-loop resonating

Signature of a bus obtained from single outer loop and multiple inner loop
Results from the Mutually Coupled Multiple Loop Detector with Outer-loop resonating

Signature of a car obtained from single outer loop and multiple inner loop

Signature obtained for the continuous movement of vehicles from single outer loop and multiple inner loop
Thank you

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