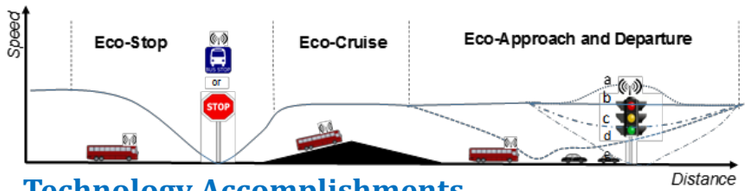
Connected Eco-Bus

An Innovative Vehicle-Powertrain Eco-Operation System for Efficient Plug-In Hybrid Electric Buses

Fed. funding	$3.15M
Length	36 mo.

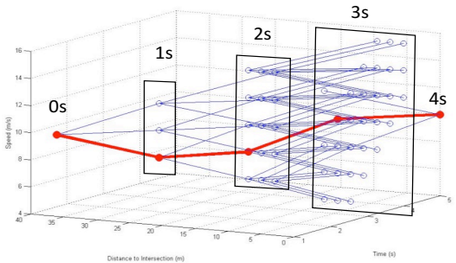
Technology Summary and Goals

- Develop an innovative vehicle-powertrain eco-operation system for plug-in hybrid electric buses through co-optimization of vehicle dynamics and powertrain controls
- Improve transit bus energy efficiency by 20+% while meeting stringent NOx emission standards
- Employ emerging connected vehicle applications such as Eco-Approach and Departure, Eco-Stop and Launch, and Eco-Cruise that generate optimal trajectories and powertrain strategies

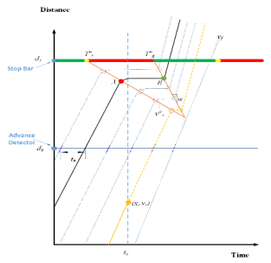


Technology Accomplishments

- New trajectory planning algorithms have been developed for specific bus constraints (Eco-Approach and Departure, Eco-Stop and Launch, Eco-Cruise, queue prediction models)
- Vehicle dynamics control is being tightly integrated with powertrain controls (optimized engine efficiency, advanced brake regenerative power)
- Working directly with hybrid bus manufacturer to maximize customer acceptance and commercialization potential



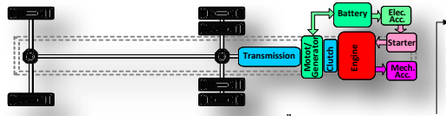
Flexible Eco-Approach and Departure strategy

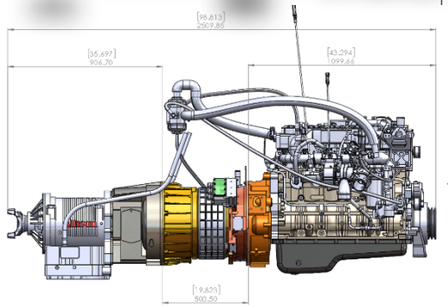


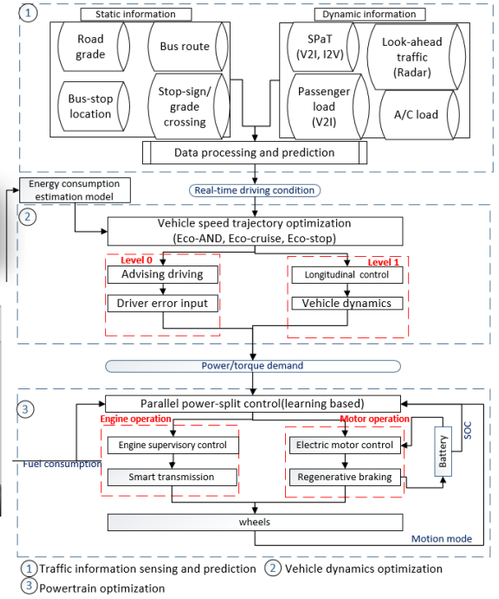
Queue prediction

Integrated Powertrain Control Strategies

Optimized engine efficiency and advanced regenerative braking have been analyzed and tightly integrated with vehicle dynamics control strategies, based on a unique plug-in power-split hybrid electric bus with natural gas ICE







Strategy		Description	Savings	Source
Vehicle Dynamic (VD) Control	Eco-Approach and Departure	Determines energy-efficient speed profile based on signal phase and timing, queue, and road grade information	27%	Project Tech Memo (2018)
	Eco-Stop and launch	Determines energy-efficient speed profile for decelerating to and accelerating from bus stops and stop signs	13%	
	Eco-Cruise	Determines cruising speed profile based on look-ahead traffic and terrain conditions	31%	
Powertrain (PT) Control	CEED based powertrain control	Control battery state-of-charge and optimize engine/motor operation mode	14%	
	Intelligent Energy Management	Optimizes power split between ICE and electric motor for the vehicle speed and power demand profiles	12% (future)	Qi *et al.* (2016)
Proposed Technology		Integration of above strategies with VD&PT co-optimization	>20%	

Dynamometer-in-the-Loop Testing

Dynamometer is driven based on traffic simulation or remote vehicle operation

Tech-to-Market Strategy

- Coordinating T2M plan with UC Technology Transfer and UC Research and Economic Development staff
- Working closely with US Hybrid to commercialize the plug-in hybrid electric bus technology targeted at transit agencies
- High degree of interaction and interviews with transportation technology companies and operators
- Developing a toolkit of algorithms that can be licensed towards other transportation modes beyond transit
- Integrating route optimization as part of overall energy management system