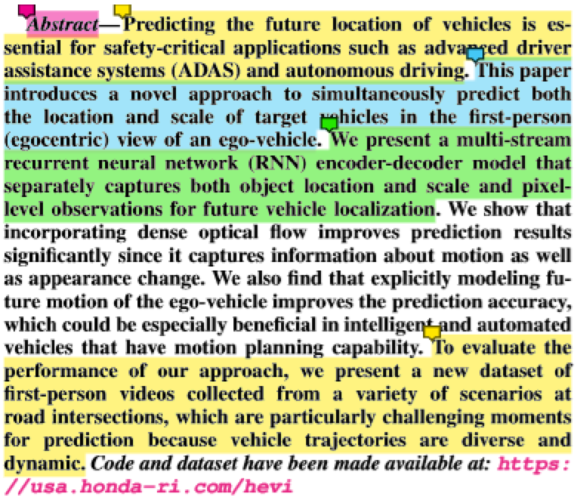
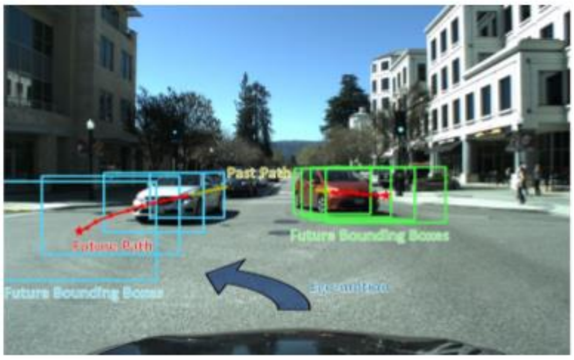


Abstract—Predicting the future location of vehicles is essential for safety-critical applications such as advanced driver assistance systems (ADAS) and autonomous driving. This paper introduces a novel approach to simultaneously predict both the location and scale of target vehicles in the first-person (egocentric) view of an ego-vehicle. We present a multi-stream recurrent neural network (RNN) encoder-decoder model that separately captures both object location and scale and pixel-level observations for future vehicle localization. We show that incorporating dense optical flow improves prediction results significantly since it captures information about motion as well as appearance change. We also find that explicitly modeling future motion of the ego-vehicle improves the prediction accuracy, which could be especially beneficial in intelligent and automated vehicles that have motion planning capability. To evaluate the performance of our approach, we present a new dataset of first-person videos collected from a variety of scenarios at road intersections, which are particularly challenging moments for prediction because vehicle trajectories are diverse and dynamic. *Code and dataset have been made available at:* https://usa.honda-ri.com/hevi

Purpose: Predicting the future location of vehicles. Introducing a novel approach to simultaneously predict both the location and scale of target vehicles in the first-person(egocentric) view of an ego-vehicle.

Method: Proposing **a multi-stream recurrent neural network (RNN) encoder-decoder model** (that separately capture both object location and scale and pixel-level observation for future vehicle localization)



Problem: Extensive research has been conducted on predicting vehicles' future action and trajectories using overhead(bird's eye view) observations. But obtaining overhead views requires additional equipment like an externally-mounted camera(or LiDAR).

Suggestion: natural approach is to use forward-facing cameras that record the driver's egocentric perspective

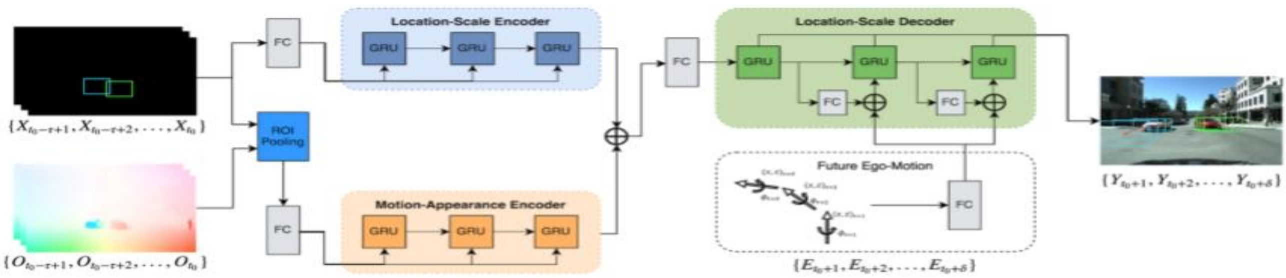
1. 지능적 주행시스템이 자기중심의 관점에서 교차로와 같은 까다로운 주행 시나리오에서 차량의 future location을 예측할 수 있는 새로운 관점을 제시함

2. 조밀한 광학 흐름(dense optical flow)과 future ego-motion을 입력으로 사용해 시간 모델링을 개선하고 차량의 움직임과 외관 정보를 명시적으로 캡처할 수 있는 multi-stream RNN-ED 아키텍처 제안함.

3. 도로 교차로와 관련된 다양한 시나리오에서 수집된 새로운 1인칭 video dataset(HONDA Egocentric View-Intersection(HEV-I)dataset)를 게시함 (dataset에는 230개 비디오에 2400개 이상의 차량(after filtering)이 포함)

This paper considers the challenging problem of predicting relative future locations and scales of nearby vehicles with respect to an ego-vehicle equipped with an egocentric camera.

By a multi-stream RNN encoder-decoder(RNN-ED) architecture to effectively encode past observations from different domains and generate future bounding box.



차량의 특징들은 optical flow map으로부터 이중선형보간을(bilinear interpolation) 사용하여 관심영역 풀링동작(ROIPooling)에 의해 추출됨

The resulting relative motion vector is represented as $O_t = [u_1, v_1, u_2, v_2, ... u_n, v_n]_t$, where n is the size of the pooled region.

$h^X_t = GRU_X(\phi_X(X_{t-1}), h^X_{t-1}; \theta_X)$

$h^O_t = GRU_O(\phi_O(O_{t-1}), h^O_{t-1}; \theta_O)$

$H = \phi_H(Average(h^X_{t_0}, h^O_{t_0}))$

(GRU는 매개 변수 θ - gated recurrent unit

φ (·)는 ReLU 활성화를 사용한 선형 투영

h^x_t 및 h^o_t는 시간 t에서 GRU 모델의 숨겨진 상태 벡터)