Reconstructing Vehicles from a Single Image

**Objective (Ill posed!)**

**Input**: RGB image of a car

**Output**: 3D Pose and Shape

**Proposed Pipeline**

1. Input Image
2. Localized Keypoints
3. Initialization of Shape and Pose
4. Pose Adjustment
5. Shape Adjustment
6. Rendered CAD Model

**Shape Priors**

A mean shape and a set of deformation basis vectors constitute the learnt shape prior.

\[ S = S + \sum_{k=1}^{K} \lambda_k V_k \]

**Shape-Aware Adjustment**:

We use several constraints and define a nonlinear least squares problem that recovers shape (\( \lambda \)).

Constraints that we use:
- Keypoint reprojection error
- Planarity
- Symmetry
- Regularizers

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**Deep learning helps**

- We train a deep, fully convolutional regressor to predict a set of discriminative keypoints, given an image.