Variational Autoencoded Regression: High Dimensional Regression of Visual Data on Complex Manifold

Youngjoon Yoo, Sangdoo Yun, Hyung Jin Chang, Yiannis Demiris, and Jin Young Choi

SEOUL NATIONAL UNIVERSITY

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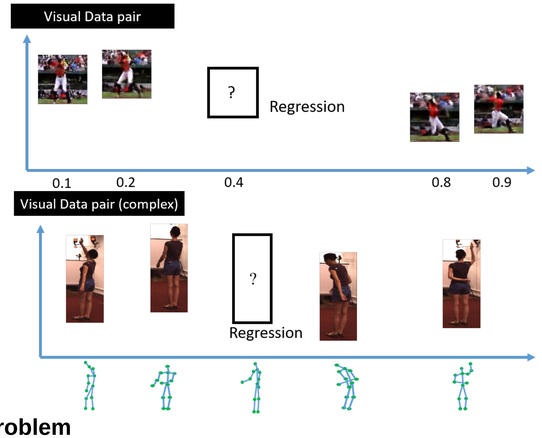
Motivation

Regression for complex response

- Dealing with the case when output response is set to Image.



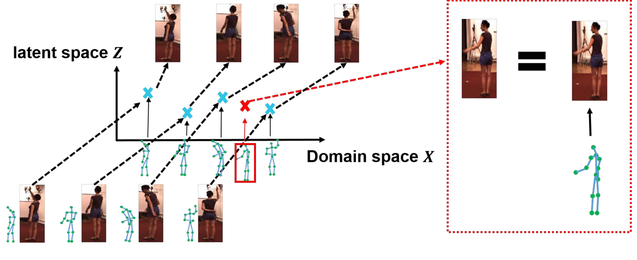
Problem

- Complex and high dimensionality of Images
- Difficult to regress, and generate the visual response.

Approach

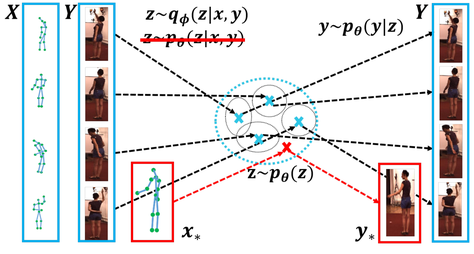
Variational Autoencoded Regression

- Map the visual data into low dimensional (latent) space
- Regression in latent space = Regression in Data space



Variational Autoencoded Regression (VAE-Regression)

Problem Setting

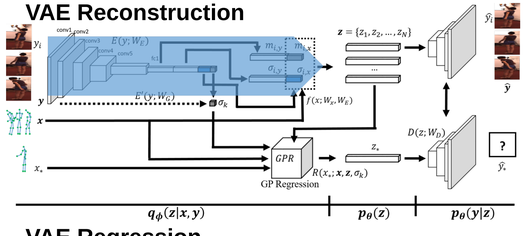


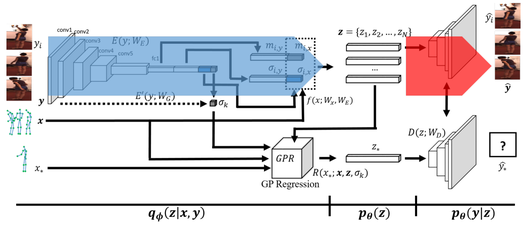
- **Find** $y_* \sim p_\theta(y|x_*, X, Y)$.
- **Minimize** $D_{KL}(q_\phi(z|x,y)||p_\theta(z|x,y))$

$$\cong -D_{KL}(q_\phi(z|x,y)||p_\theta(z)) + \sum_{i=1}^{N} log\ p_\theta(\hat{y}_i|z_i) + \sum_{j=1}^{M} log\ p_\theta(\hat{y}_j|\hat{z}_j)$$

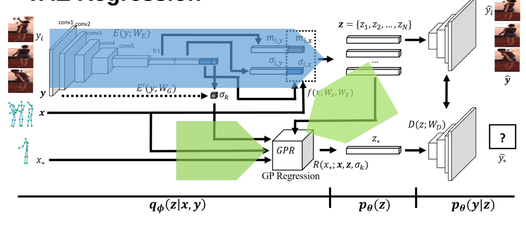
(1) $p_\theta(z) \sim N(0, I)$
(2) $q_\phi(z|x,y) \sim N(m, \sigma)$ $\quad z = z_i$
(3) $q_\phi(z|x,y) \sim GPR(z; X, Y, x_*)$ $\quad z = z_j$

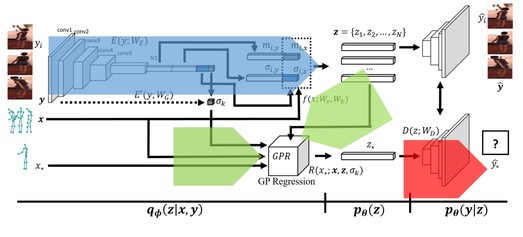
VAE Reconstruction





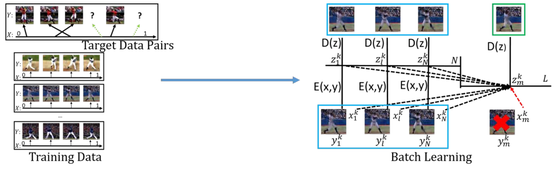
VAE Regression





Training method

- Batch Generation



- Fine Tuning

1 epoch, few iterations

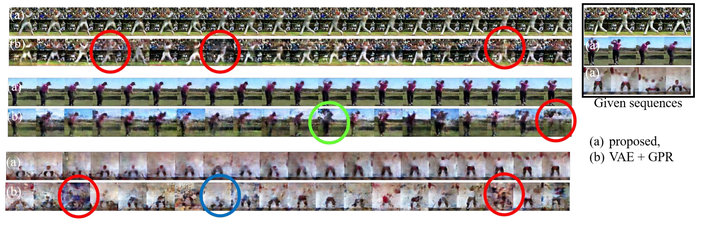
Experiments

Experiment setting

- Tensorflow, i7-4790K CPU, Nvidia Titan X GPU.
- H36m and Youtube captured dataset

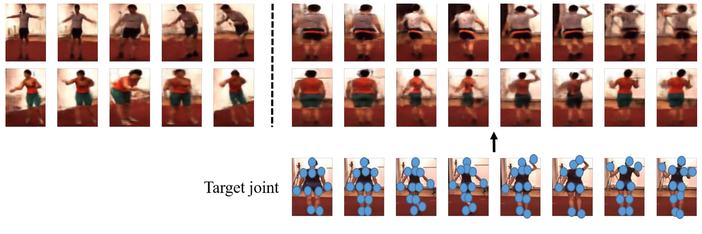
Simple Domain – Complex response

- Domain – relative order, Response – Image



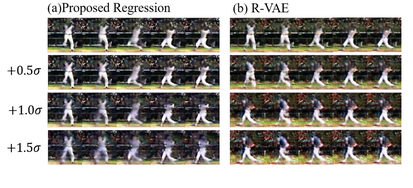
Complex Domain – Complex response

- Domain – Joint vector, Response – Image (256 by 256, adding GAN)



Further Analysis

1. Robustness



2. Convergence