Weakly-supervised Transfer for 3D Human Pose Estimation in the Wild
Supplementary Material

Appendix

A. Detail of geometry constraint loss

0.0.1 Forward

We consider four groups of bones, defined by G = {arm, leg, shoulder, hip}.

$R_{arm} =$ {left lower arm, left upper arm, right lower arm, right upper arm}, R_{leg} = {left lower leg, left upper leg, right lower leg, right upper leg}, $R_{shoulder}$ = { left shoulder bone, left shoulder bone}, R_{hip} = {left hip bone, left hip bone}.

A bone (e.g. left lower arm) is represented by the index of its two end-points, e = (j_L, j_R), i.e., left lower arm = (left wrist, left elbow). Let $Y_{2D}^{(j)} = (u^{(j)}, v^{(j)})$, we have

$$l_e = ||Y_{3D}^{(j_L)}, Y_{3D}^{(j_R)}||$$
$$= \sqrt{(u^{(j_L)} - u^{(j_R)})^2 + (v^{(j_L)} - v^{(j_R)})^2 + (\hat{Y}_{dep}^{(j_L)} - \hat{Y}_{dep}^{(j_R)})^2}$$

Reminder that $\bar{l}_e$ is a pre-defined constant, we have

$$L_{geo}(\hat{Y}_{dep}|Y_{2D}) = \sum_{i \in G} \frac{1}{|R_i|} \sum_{e \in R_i} \left(\frac{l_e}{\bar{l}_e} - \bar{r}_i\right)^2,$$

where

$$\bar{r}_i = \frac{1}{|R_i|} \sum_{e \in R_i} \frac{l_e}{\bar{l}_e}.$$

0.1. Backward

$$\frac{\partial L_{geo}}{\partial l_e} = \frac{\partial}{\partial l_e} \sum_{i \in G} \frac{1}{|R_i|} \sum_{e \in R_i} \left(\frac{l_e}{\bar{l}_e} - \bar{r}_i\right)^2$$
$$= \frac{\partial}{\partial l_e} \sum_{i \in G} \left(\frac{1}{|R_i|} \sum_{e \in R_i} \left(\frac{l_e}{\bar{l}_e}\right)^2 - \left(\frac{1}{|R_i|} \sum_{e \in R_i} \frac{l_e}{\bar{l}_e}\right)^2\right)$$
$$= \sum_{i \in G} \frac{2}{|R_i|} \sum_{e \in R_i} \frac{1}{\bar{l}_e} \left(\frac{l_e}{\bar{l}_e} - \bar{r}_i\right)$$

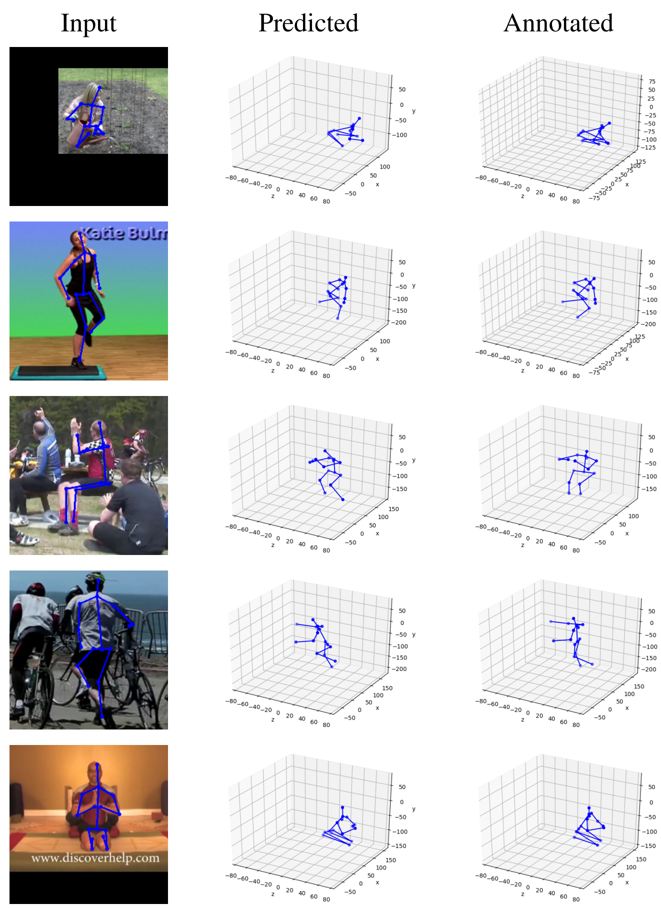
Let e = (j, j')

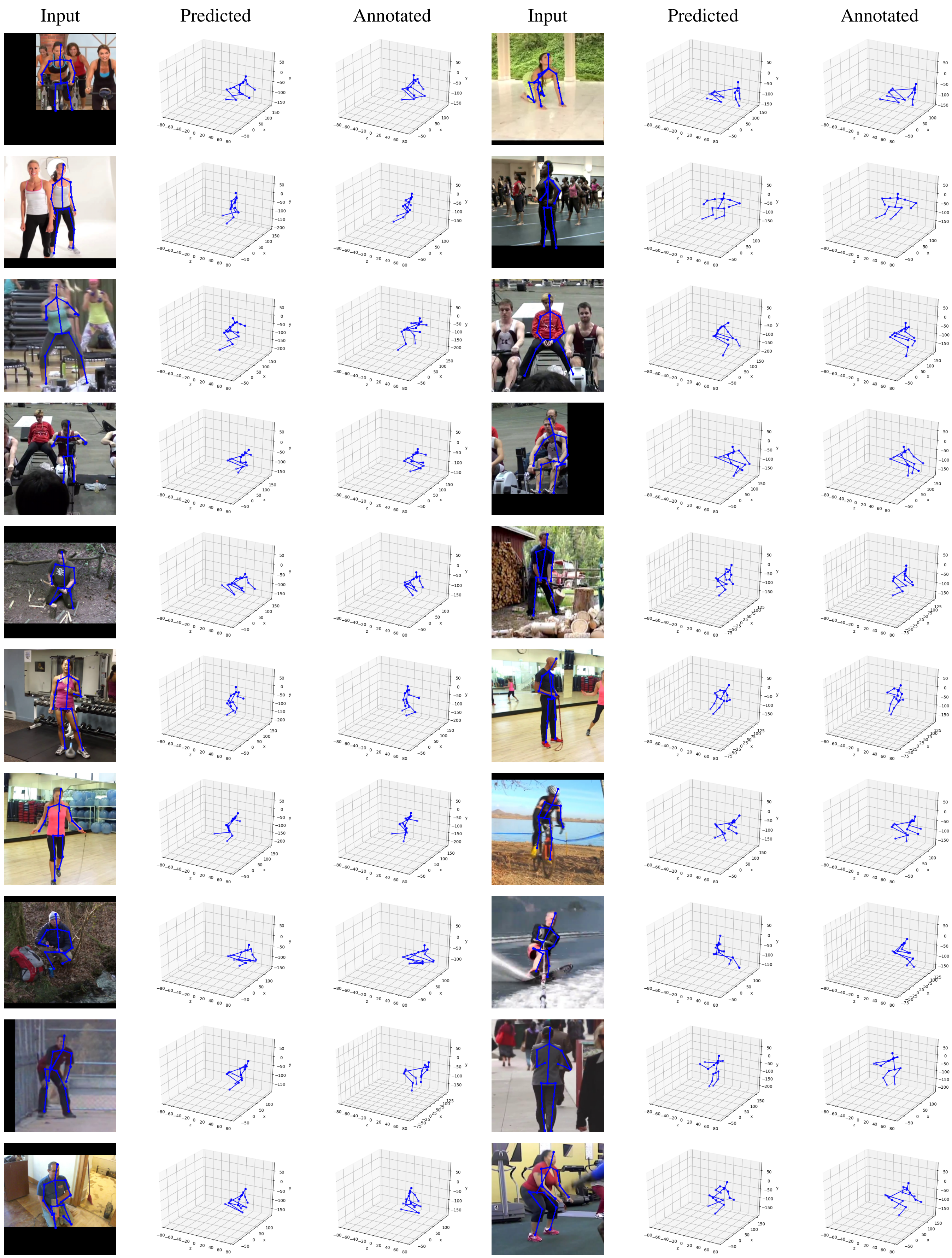
$$\frac{\partial l_e}{Y_{dep}^{(j)}} = \frac{1}{l_e}(Y_{dep}^{(j)} - Y_{dep}^{(j')})$$

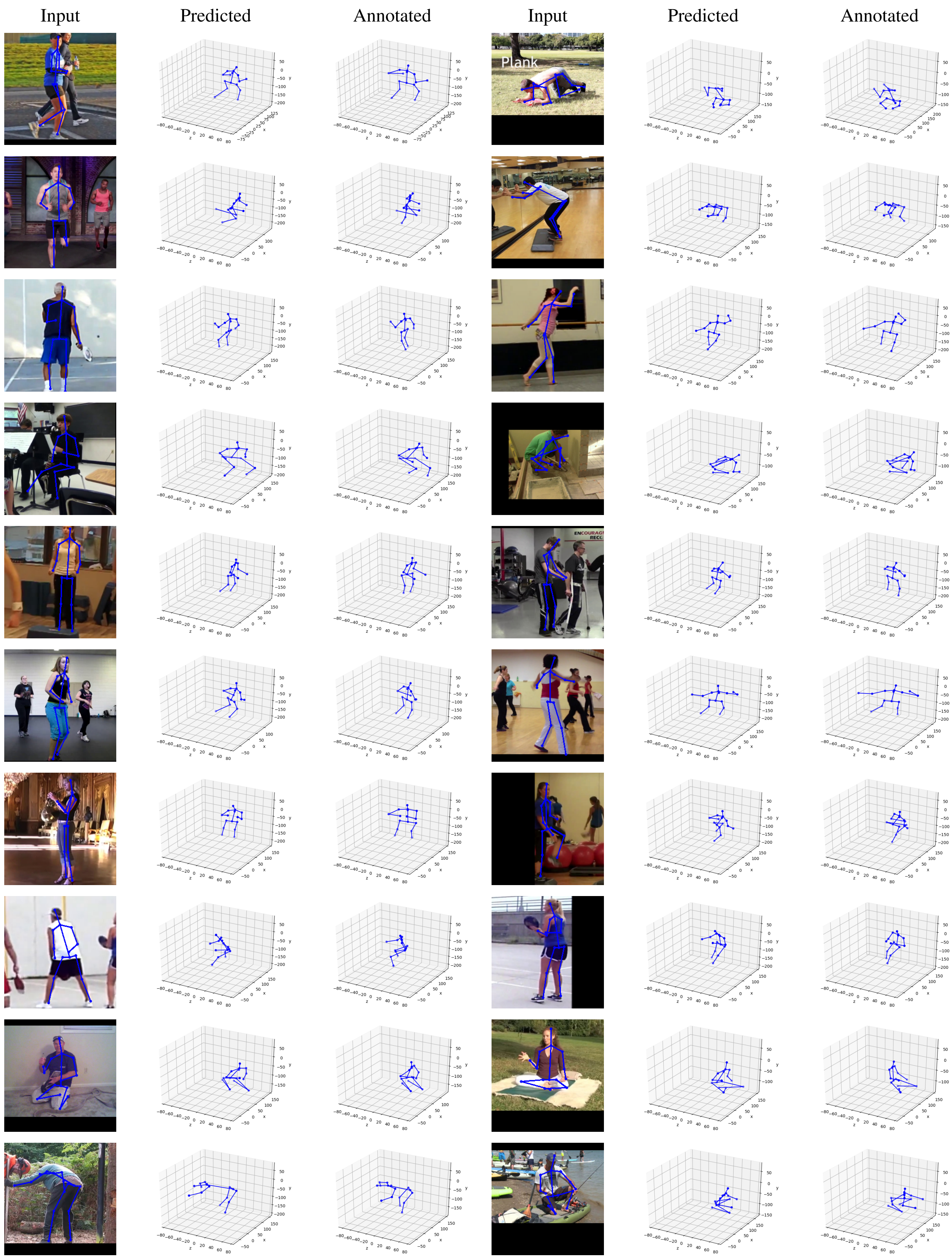
So we have

$$\frac{\partial L_{geo}}{\partial \hat{Y}_{dep}^{(j)}} = \frac{\partial L_{geo}}{\partial l_e} \frac{\partial l_e}{\partial \hat{Y}_{dep}^{(j)}}$$
$$= \sum_{i \in G} \frac{2}{|R_i|} \sum_{e \in R_i} \frac{1}{\bar{l}_e l_e} \left(\frac{l_e}{\bar{l}_e} - \bar{r}_i\right)(Y_{dep}^{(j)} - Y_{dep}^{(j')})$$

1. More Qualitative results




Input
Predicted
Annotated
Input
Predicted
Annotated
x
y
z


Input
Predicted
Annotated
Input
Predicted
Annotated
Plank

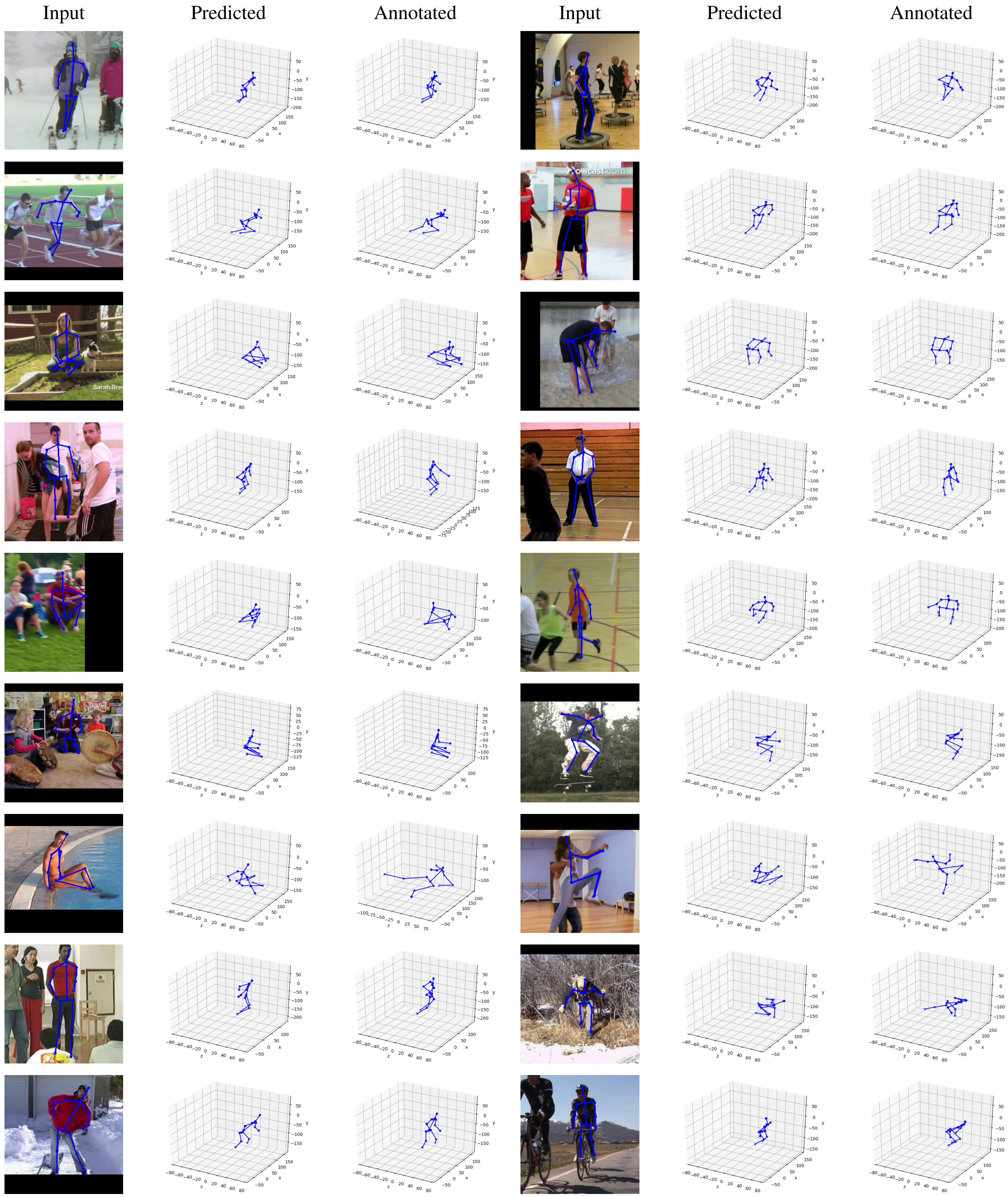


Table 1. Qualitative results from MPII validation 3D sets. We show our predicted poses and our annotated poses (Section 4). Our framework performs well in a wide range of poses and situations. Typical failure cases (the last three lines) include inaccurate 2D prediction, ambiguous depth, and false torso length.