ARCH: Animatable Reconstruction of Clothed Humans

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Overview
ARCH is an end-to-end framework for accurate reconstruction of animation-ready 3D clothed humans from a monocular image.
• ARCH is a learned pose-aware model that produces detailed 3D rigged full-body human avatars from a single unconstrained RGB image.
• A Semantic Space and a Semantic Deformation Field are created using a parametric 3D body estimator. They allow the transformation of 2D/3D clothed humans into a canonical space, reducing ambiguities in geometry caused by pose variations and occlusions in training data.
• Detailed surface geometry and appearance are learned using an implicit function representation with spatial local features.
• Furthermore, we propose additional per-pixel supervision on the 3D reconstruction using opacity-aware differentiable rendering.

Our Method uses a fitted template model, trains and predicts in canonical space, yielding animation-ready model:

ARCH (Ours) robustly handles arbitrary poses with self-contacts and occlusions, and reconstructs higher level of details than existing methods. Outputs are rigged and animation-ready.

3D body estimation is performed by DenseRaC. We evaluate on 3D scan datasets and Internet images.

Experiments

<table>
<thead>
<tr>
<th>Methods</th>
<th>RenderPeople</th>
<th>BF/FP</th>
</tr>
</thead>
<tbody>
<tr>
<td>BodyNet</td>
<td>0.29</td>
<td>0.52</td>
</tr>
<tr>
<td>SiDoH</td>
<td>0.22</td>
<td>0.40</td>
</tr>
<tr>
<td>V-Geo</td>
<td>0.20</td>
<td>0.34</td>
</tr>
<tr>
<td>VRN</td>
<td>0.12</td>
<td>1.52</td>
</tr>
<tr>
<td>PIFu</td>
<td>0.08</td>
<td>1.52</td>
</tr>
<tr>
<td>ARCH, baseline</td>
<td>0.080</td>
<td>1.58</td>
</tr>
<tr>
<td>+ SemPF</td>
<td>0.052</td>
<td>0.74</td>
</tr>
<tr>
<td>+ GSR</td>
<td>0.058</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Reference:
[4] DenseRaC — Xu et al., “Joint 3D Pose and Shape Estimation by Dense Render-and-Compare”, ICCV19