Geometry Driven Progressive Warping for One-Shot Face Animation

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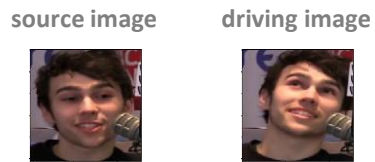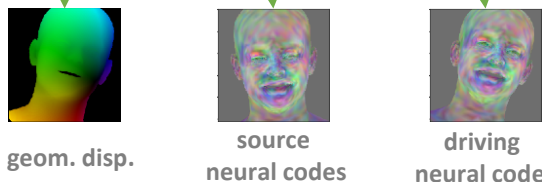
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Introduction

- Displacement field estimation is important for face motion transfer
- How to generate accurate displacement field?
- Our proposed method
  - *Geometric displacement field* and *posed neural codes* as guidance
  - Progressive warping module (PWM)

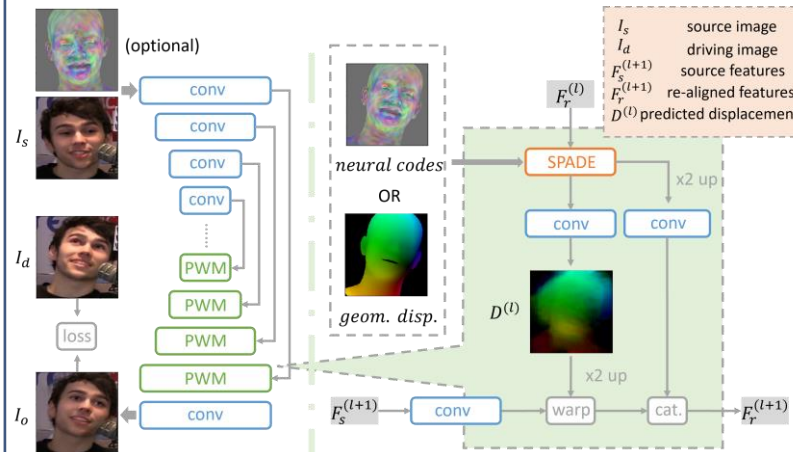## Geometric Guidance

source image   driving image

- Geometric displacement field
  - Compute the displacements between source and driving face meshes
  - Render the displacements using the driving mesh topology
- Posed neural codes
  - Attach a learnable embedding to template mesh
  - Render the embedded template using the source and driving mesh topologies

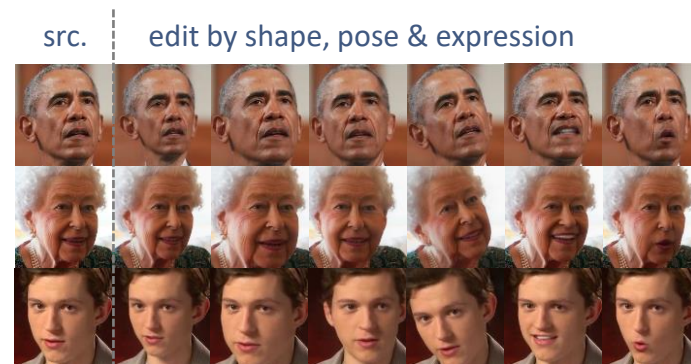geom. disp.   source neural codes   driving neural codes

Progressive Warping Module (PWM)

- Designed for better feature (re-)alignment
- Alternates between feature (re-)alignment (warping) and displacement estimation

Architecture Overview

I_s source image
I_d driving image
$F_s^{(l+1)}$ source features
$F_r^{(l+1)}$ re-aligned features
$D^{(l)}$ predicted displacement

Face Editing

src. | edit by shape, pose & expression

Experiments

	VoxCeleb1								
	Same Identity Reconstruction				Cross Identity Reconstruction			
	FID↓	CSIM↑	AKD↓	AED↓	APD↓	FID↓	CSIM↑	AED↓	APD↓
X2Face	36.02	0.532	10.94	0.201	5.189	51.14	0.437	0.297	7.421
Bi-Layer	79.05	0.580	3.11	0.129	0.866	87.54	0.461	0.230	1.493
LSR	20.53	0.311	2.73	0.153	1.012	28.04	0.229	0.217	1.606
FOMM	10.87	0.788	2.25	0.087	0.688	30.84	0.562	0.218	1.612
3D-FOMM	5.47	0.792	2.23	0.091	0.770	22.34	0.605	0.247	2.149
HeadGAN	10.72	0.779	3.80	0.087	1.097	25.79	0.505	0.234	1.849
PIRender	9.47	0.745	3.41	0.119	1.148	23.82	0.530	0.222	1.916
PWM + NMFC	5.57	0.784	2.32	0.091	0.786	15.73	0.647	0.225	1.641
PWM + geom. disp.	3.95	0.794	2.29	0.081	0.756	14.19	0.653	0.228	1.668
PWM + neural codes	3.93	0.793	2.15	0.067	0.670	14.32	0.584	0.174	1.214
PWM + geom. disp. + neural codes	4.33	0.794	2.14	0.066	0.664	15.39	0.590	0.173	1.224
PWM + geom. disp. + neural codes (BFM)	4.80	0.779	4.04	0.087	1.110	16.78	0.546	0.233	1.956

	VoxCeleb2								
	Same Identity Reconstruction				Cross Identity Reconstruction			
	FID↓	CSIM↑	AKD↓	AED↓	APD↓	FID↓	CSIM↑	AED↓	APD↓
X2Face	30.34	0.538	21.66	0.188	7.780	41.31	0.379	0.280	9.757
Bi-Layer	57.26	0.541	2.84	0.138	1.153	66.22	0.436	0.221	1.780
LSR	12.43	0.275	2.66	0.156	1.388	18.17	0.217	0.214	1.928
FOMM	8.32	0.718	2.69	0.118	1.291	26.00	0.475	0.231	2.545
3D-FOMM	3.49	0.723	3.11	0.118	1.498	14.52	0.567	0.240	3.189
HeadGAN	8.59	0.704	3.87	0.112	1.665	19.47	0.473	0.227	2.647
PIRender	7.77	0.677	3.47	0.144	1.758	19.15	0.508	0.229	2.852
PWM + NMFC	4.17	0.725	2.64	0.118	1.162	10.68	0.601	0.230	2.142
PWM + geom. disp.	3.14	0.732	2.69	0.111	1.203	9.83	0.612	0.234	2.564
PWM + neural codes	3.29	0.723	2.37	0.087	0.954	10.15	0.528	0.177	1.498
PWM + geom. disp. + neural codes	3.18	0.726	2.36	0.088	0.954	9.97	0.541	0.178	1.533
PWM + geom. disp. + neural codes (BFM)	3.63	0.721	3.70	0.109	1.552	11.15	0.516	0.227	2.569

Face Reenactment: Same Id & Cross Id

src. | drv. | geom. disp. | neural codes   src. | drv. | geom. disp. | neural codes