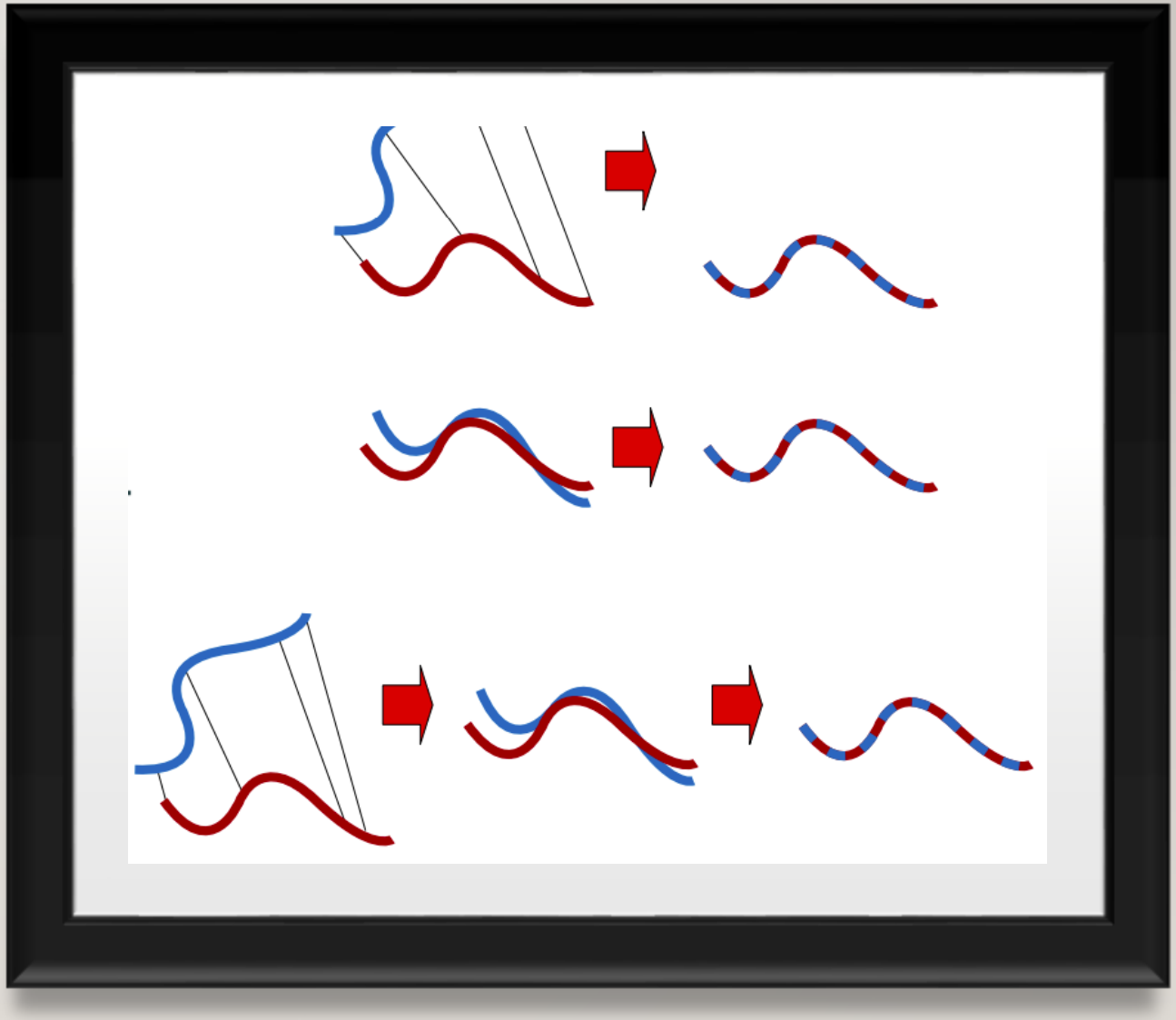
3D SHAPE REGISTRATION

DUST3R VS COLMAP

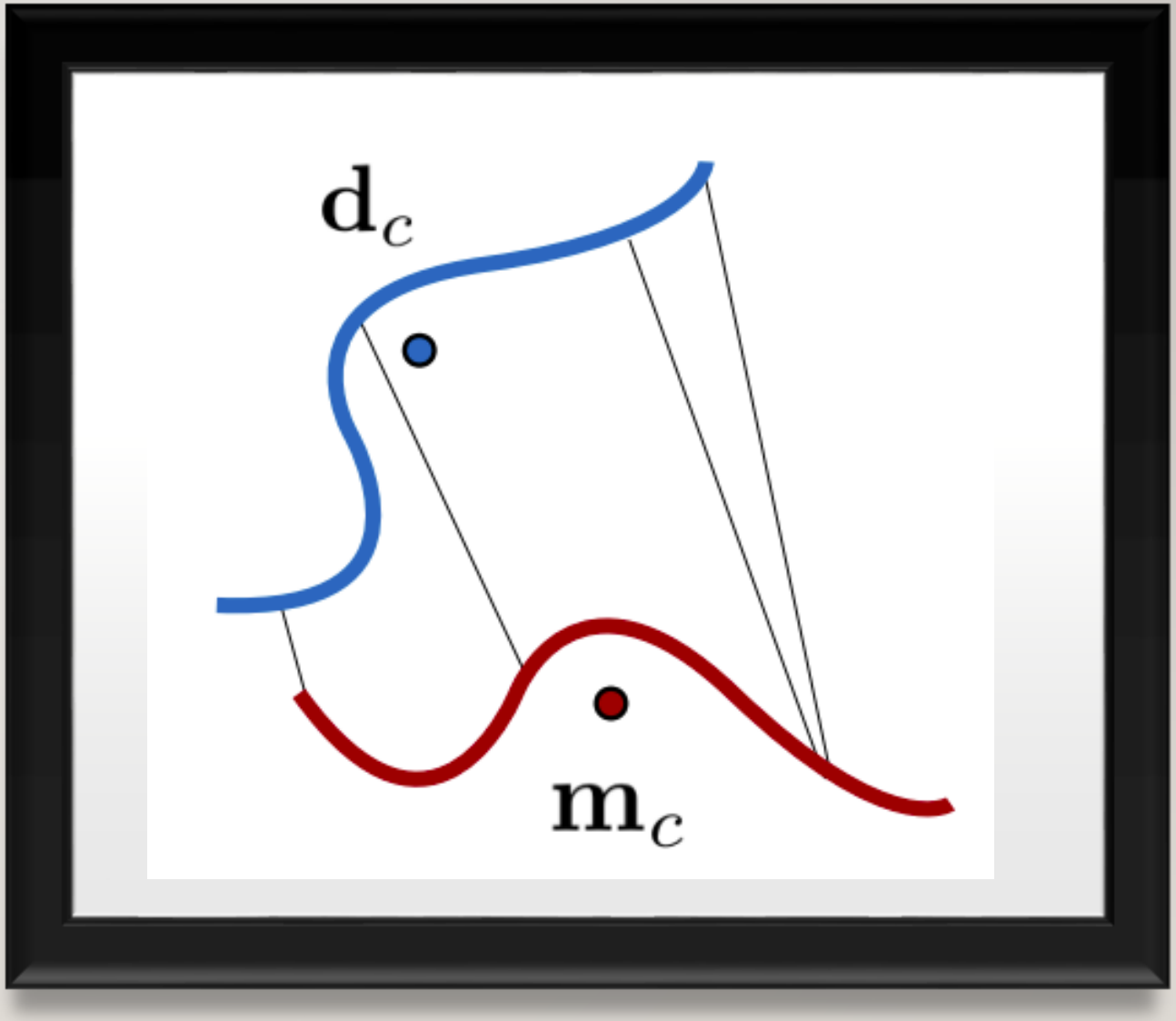
Methods	N Frames	Co3Dv2 [93]			RealEstate10K [185]
		RRA@15	RTA@15	mAA(30)	mAA(30)
COLMAP+SPSG	3	~22	~14	~15	~23
PixSfM	3	~18	~8	~10	~17
Relpose	3	~56	-	-	-
PoseDiffusion	3	~75	~75	~61	- (~77)
DUSt3R 512	3	95.3	**88.3**	**77.5**	**69.5**
COLMAP+SPSG	5	~21	~17	~17	~34
PixSfM	5	~21	~16	~15	~30
Relpose	5	~56	-	-	-
PoseDiffusion	5	~77	~76	~63	- (~78)
DUSt3R 512	5	95.5	86.7	76.5	67.4
COLMAP+SPSG	10	31.6	27.3	25.3	45.2
PixSfM	10	33.7	32.9	30.1	49.4
Relpose	10	57.1	-	-	-
PoseDiffusion	10	80.5	79.8	66.5	48.0 (~80)
DUSt3R 512	10	**96.2**	86.8	76.7	67.7

- Finding a rigid body transformation for 2 point maps which maximize the overlap between two point clouds.



- Find optimal solution for:

$$\{\hat{\mathbf{R}}, \hat{\mathbf{t}}\} = \arg\min_{\mathbf{R},\mathbf{t}} \sum_{i=1}^{n} \|\mathbf{m}_i - (\mathbf{R}\mathbf{d}_i + \mathbf{t})\|^2$$



ITERATIVE CLOSEST POINT ALGORITHM

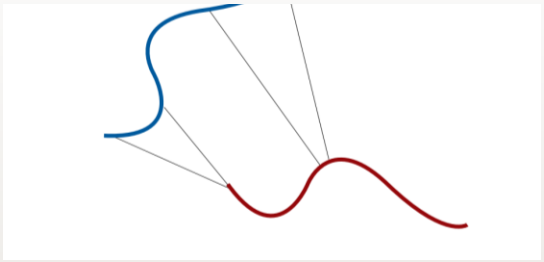
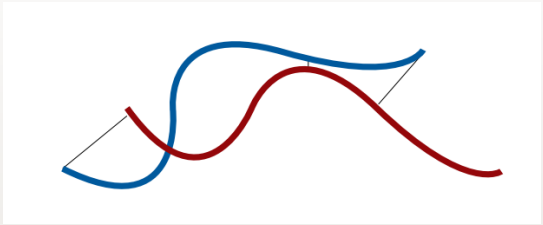
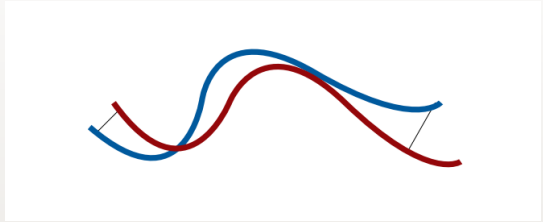
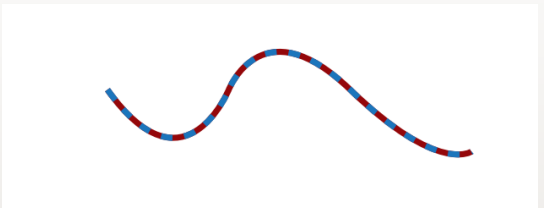
- Iterate to find good alignment.
- Requires a good initial guess for R,t
- guaranteed to converge to a local minimum of E(R, t)
- Can use LM(Levenberg–Marquardt) OR SVD to find registration error

HOW ICP WORKS

- Compute R,t
- Compute the error:

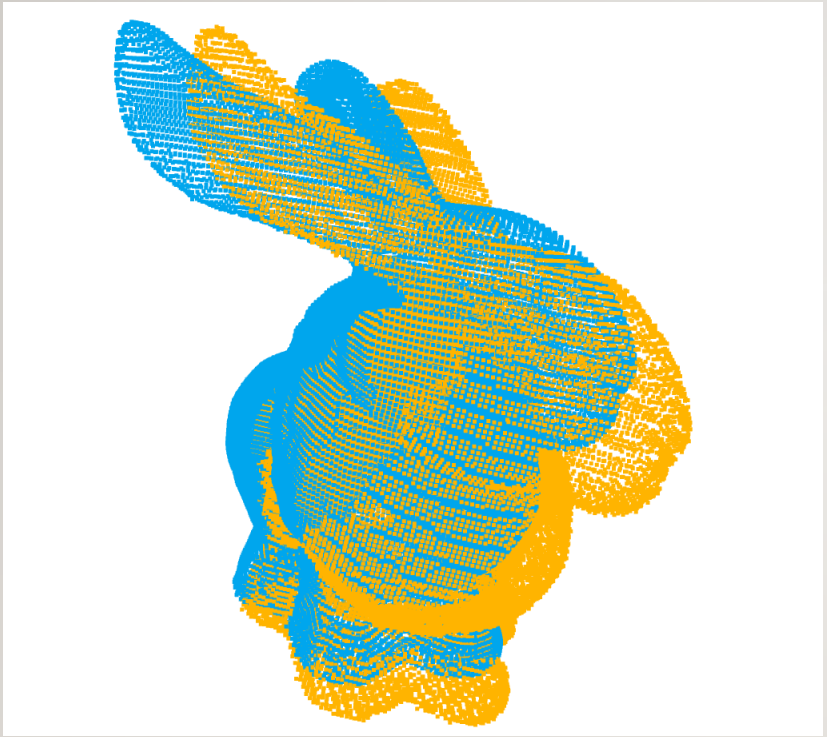
$$E(\mathbf{R}, \mathbf{t}) = \sum_{i=1}^{n_D} \|\mathbf{m}_{j(i)} - (\mathbf{R}\mathbf{d}_i + \mathbf{t})\|^2$$

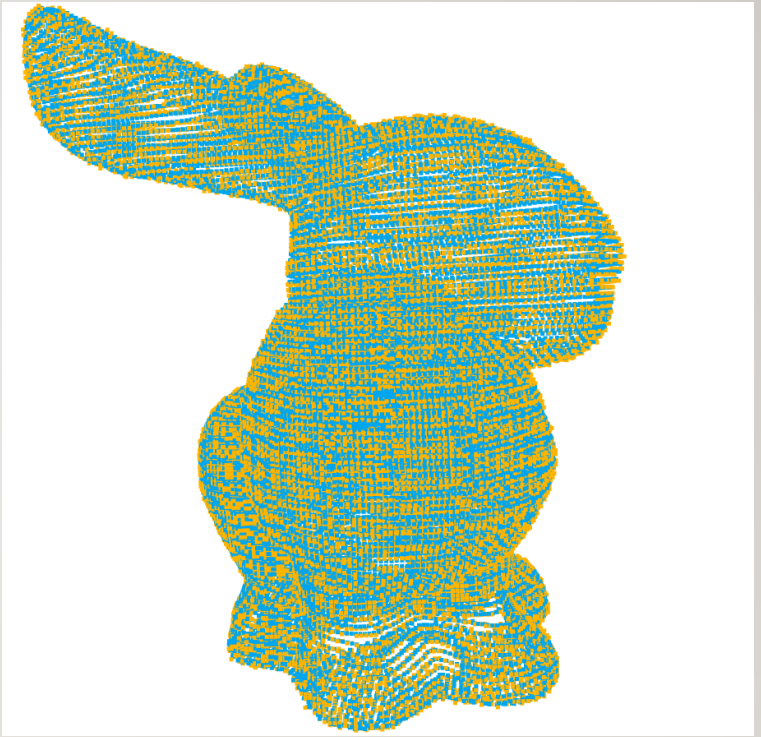
- If error E decreased and E < threshold, stop
- Otherwise do the loop again

1	2	3	4
			

OPEN3D

- Open-source library
- Use open3D point cloud
- Can load and Visualize Point Clouds
- USE KDTree to find closet point
- Save output in .ply file





EXAMPLE

WHAT WE HAVE DONE SO FAR

- Reach to Point map of a set of images(torch) with help of DUST3R
- Convert to PLY
- Find translation and rotation

OUR OUTPUT

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