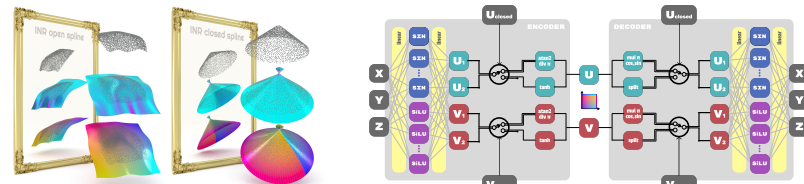


## Point2CAD: Reverse Engineering CAD Models from 3D Point Clouds

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Columns: **1.** input point cloud, **2.** ground truth mesh, **3.** reconstruction by ComplexGen, **4.** HPNet segmentation + Point2CAD, **5.** ParSeNet segmentation + Point2CAD, **6.** GT segmentation + Point2CAD.

**Point2CAD** reconstructs complex CAD models from 3D point clouds. A point cloud is segmented into clusters corresponding to CAD faces. Each face is fitted with a geometric primitive or a parametric surface using a novel neural representation (INR). Due to the analytic representation, the surfaces can be extended and intersected to obtain topology, which is then used to clip the primitives and obtain *B*-rep format. Point2CAD sets a state of the art on the ABC benchmark of CAD models.



The novel INR design of smooth freeform surfaces (open and closed)

Surfaces		$\theta_{\text{surface}} = 0.08$			$\theta_{\text{surface}} = 0.06$			$\theta_{\text{surface}} = 0.03$		
Method	Segmentation	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$
ComplexGen	N/A	0.732	0.732	0.731	0.633	0.641	0.637	0.370	0.388	0.379
Point2CAD	ParseNet	0.776	<b>0.734</b>	0.754	0.720	0.653	0.685	0.578	0.520	0.547
Point2CAD	HPNet	<b>0.815</b>	0.733	<b>0.772</b>	<b>0.770</b>	<b>0.664</b>	<b>0.713</b>	<b>0.644</b>	<b>0.540</b>	<b>0.587</b>
Point2CAD	GT	0.975	0.882	0.926	0.954	0.848	0.898	0.838	0.731	0.781

Edges		$\theta_{\text{edge}} = 0.06$			$\theta_{\text{edge}} = 0.03$			$\theta_{\text{edge}} = 0.02$		
Method	Segmentation	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$
ComplexGen	N/A	0.687	0.641	0.663	0.421	0.396	0.408	0.290	0.279	0.284
Point2CAD	ParseNet	<b>0.689</b>	0.644	0.666	0.426	<b>0.460</b>	<b>0.443</b>	0.332	<b>0.381</b>	0.355
Point2CAD	HPNet	0.689	0.645	<b>0.667</b>	<b>0.430</b>	0.454	0.442	<b>0.351</b>	0.368	<b>0.360</b>
Point2CAD	GT	0.759	0.780	0.769	0.570	0.612	0.590	0.493	0.517	0.505

Corners		$\theta_{\text{corner}} = 0.03$			$\theta_{\text{corner}} = 0.02$			$\theta_{\text{corner}} = 0.01$		
Method	Segmentation	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$	precision $\uparrow$	recall $\uparrow$	F-score $\uparrow$
ComplexGen	N/A	0.667	0.633	0.650	0.483	0.454	0.468	0.217	0.203	0.210
Point2CAD	ParseNet	<b>0.669</b>	<b>0.634</b>	<b>0.651</b>	<b>0.494</b>	<b>0.547</b>	<b>0.519</b>	0.349	<b>0.401</b>	<b>0.373</b>
Point2CAD	HPNet	0.629	0.620	0.625	0.476	0.530	0.502	<b>0.353</b>	0.380	0.366
Point2CAD	GT	0.739	0.707	0.723	0.653	0.631	0.642	0.451	0.524	0.485

Quantitative evaluation of *Surfaces*, *Edges* and *Corners* reconstruction metrics on the ABC dataset with ComplexGen and flavors of Point2CAD.

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