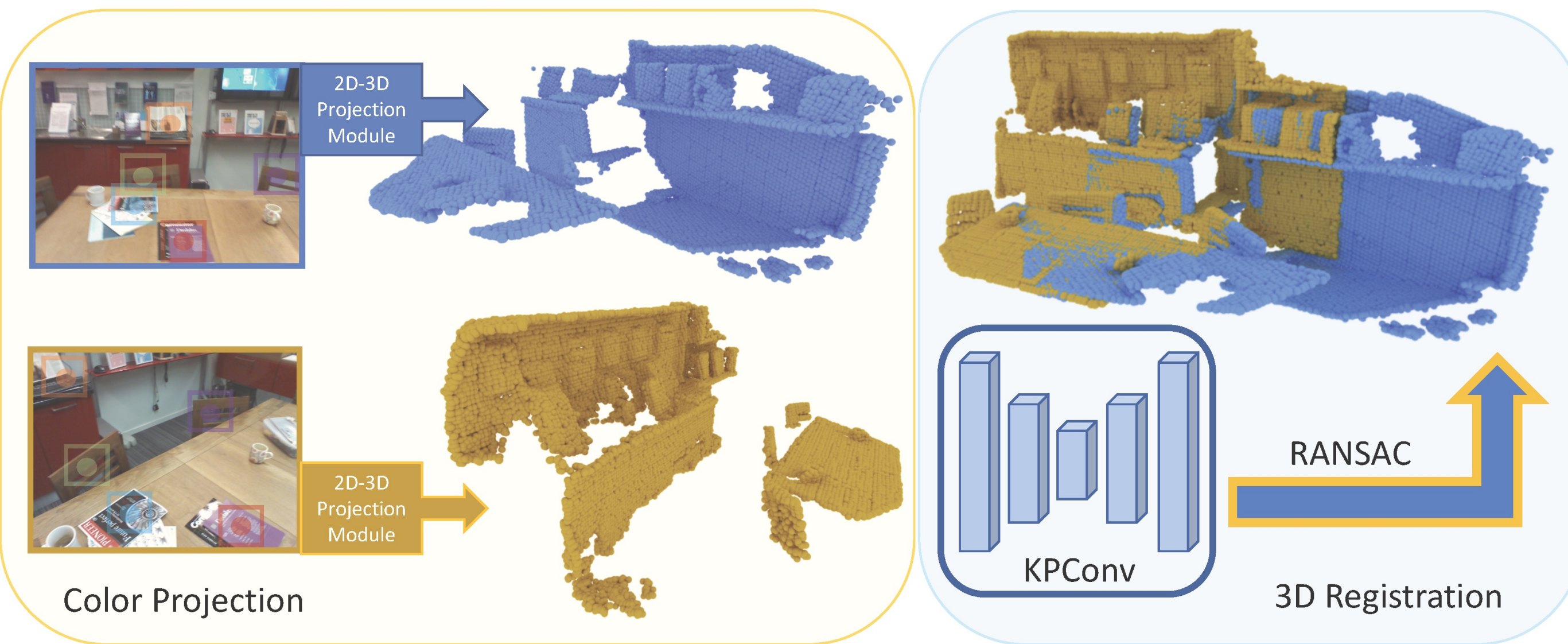


## Align Two Point Clouds in RGB-D Data

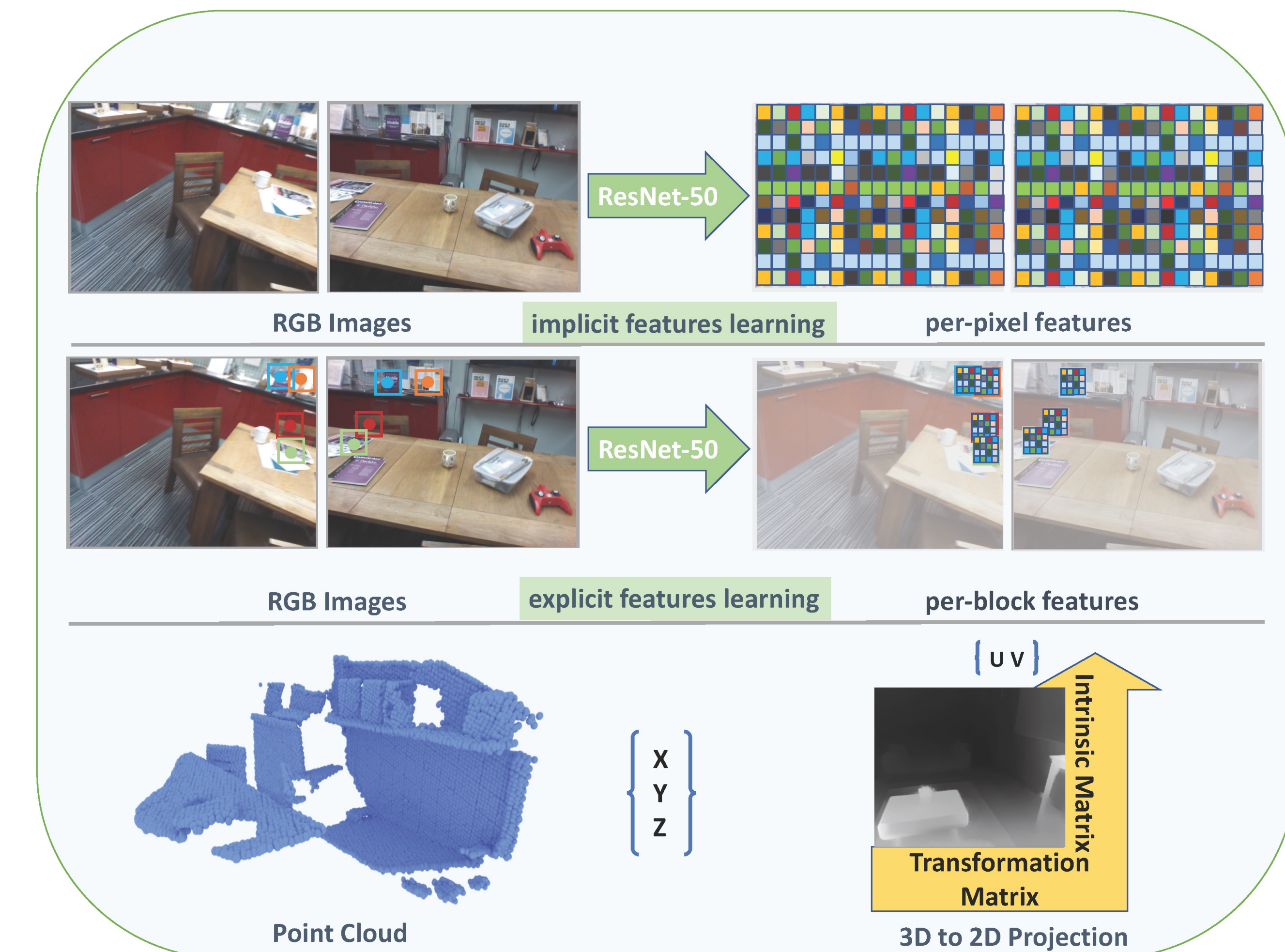


### Our contributions:

- A novel 2D-3D projection module that explicitly embeds the 2D color into the point cloud for registration task.
- Empirical studies show the transfer ability of 2D pre-trained weights for 3D point cloud registration tasks.

## Implicit vs. Explicit Features Learning

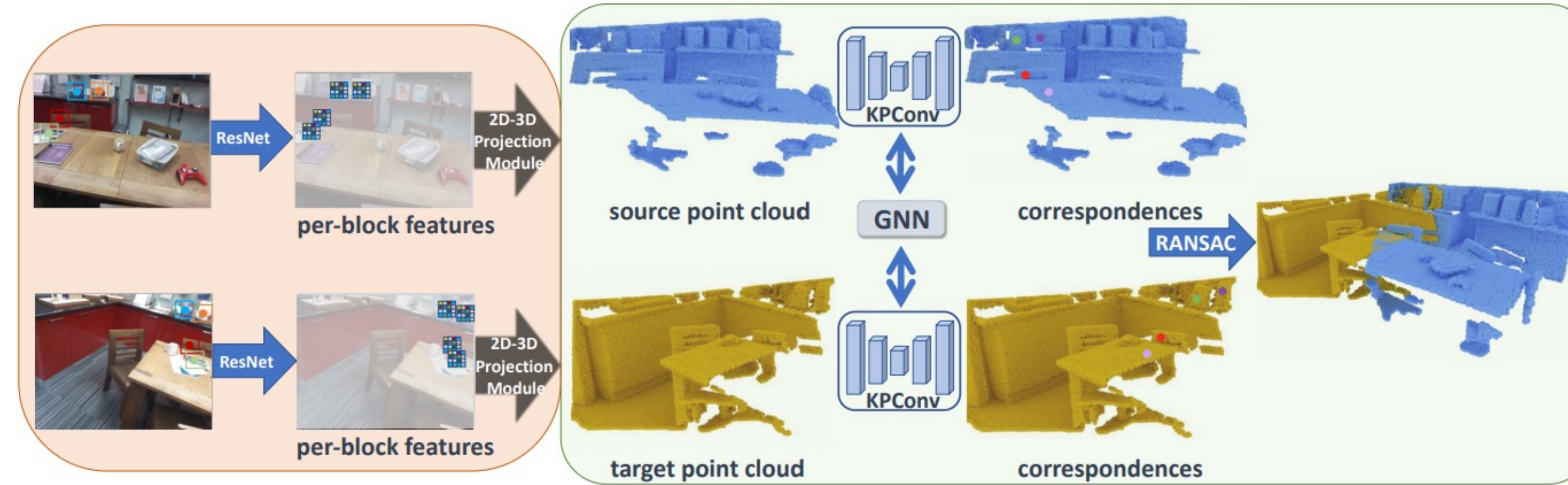
Implicit projection lifts the features of every pixel, while the other projects features of some certain pixels in an explicit manner.



## Our Approach

The pipeline is composed of a 3D network, a 2D network and a 2D-3D projection module:

- The 2D network takes RGB images as input and extracts per-region features.
- A 2D-3D Projection Module is used to lift 2D pixel features into 3D point cloud explicitly.
- The concatenated features are fed into 3D network for finding correspondences.



## Quantitative Results

# Sampled Points	3DMatch					3DLoMatch				
	5000	2500	1000	500	250	5000	2500	1000	500	250
<i>Feature Matching Recall(%) ↑</i>										
3DSN [16]	95.0	94.3	92.9	90.1	82.9	63.6	61.7	53.6	45.2	34.2
FCGF [10]	97.4	97.3	97.0	96.7	96.6	76.6	75.4	74.2	71.7	67.3
D3Feat [6]	95.6	95.4	94.5	94.1	93.1	67.3	66.7	67.0	66.7	66.5
SpinNet [1]	97.4	97.0	96.4	96.7	94.8	75.5	75.1	74.2	69.0	62.7
Predator [23]	96.6	96.6	96.5	96.3	96.5	78.6	77.4	76.3	75.7	75.3
CoFiNet [46]	<b>98.1</b>	<b>98.3</b>	<b>98.1</b>	<b>98.2</b>	<b>98.3</b>	<b>83.1</b>	<b>83.5</b>	<b>83.3</b>	<b>83.1</b>	<b>82.6</b>
Ours – PCR-CG	<u>97.4</u>	<u>97.5</u>	<u>97.7</u>	<u>97.3</u>	<u>97.6</u>	<u>80.4</u>	<u>82.2</u>	<u>82.6</u>	<b>83.2</b>	<b>82.8</b>
<i>Registration Recall(%) ↑</i>										
3DSN [16]	78.4	76.2	71.4	67.6	50.8	33.0	29.0	23.3	17.0	11.0
FCGF [10]	85.1	84.7	83.3	81.6	71.4	40.1	41.7	38.2	35.4	26.8
D3Feat [6]	81.6	84.5	83.4	82.4	77.9	37.2	42.7	46.9	43.8	39.1
SpinNet [1]	88.8	88.0	84.5	79.0	69.2	58.2	56.7	49.8	41.0	26.7
Predator [23]	89.0	<u>89.9</u>	<b>90.6</b>	<u>88.5</u>	86.6	59.8	61.2	62.4	60.8	58.1
CoFiNet [46]	<u>89.3</u>	88.9	88.4	87.4	<b>87.0</b>	<b>67.5</b>	<u>66.2</u>	<u>64.2</u>	<u>63.1</u>	<u>61.0</u>
Ours – PCR-CG	<b>89.4</b>	<b>90.7</b>	<u>90.0</u>	<b>88.7</b>	<u>86.8</u>	<u>66.3</u>	<b>67.2</b>	<b>69.0</b>	<b>68.5</b>	<b>65.0</b>

	3DMatch		3DLoMatch	
	RRE (°)	RTE (m)	RRE (°)	RTE (m)
3DSN [16]	2.199	0.071	3.528	0.103
FCGF [10]	<b>1.949</b>	0.066	3.146	0.100
D3Feat [6]	2.161	0.067	3.361	0.103
Predator [23]	2.029	<u>0.064</u>	<u>3.048</u>	0.093
CoFiNet [46]	2.002	<u>0.064</u>	3.271	<u>0.090</u>
Ours – PCR-CG	<u>1.993</u>	<b>0.061</b>	<b>3.002</b>	<b>0.087</b>

## Qualitative Results

