FG-Conv Operator:

Pointwise Feature Relation Mining(PFR)

$\{p_k\}$ $K \times (3 + f_{in})$

Correlation Score Calculating

$\{G_k\}$ $K \times 1$

A

$\{S_k\}$ $K \times 1$

$\{p'_k\}$ $K \times (3 + f_{in})$

$\{F_k^1\}$ $K \times f_1$ ($f_1 = 6 + 2f_{in}$)

Geometric Convolutional Modeling (GCM)

$\{p_k\}$ $K \times (3 + f_{in})$

Deformable Point Convolution

$\{F_k^2\}$ $K \times f_1$ ($f_1 = 6 + 2f_{in}$)

Attentional Aggregation (AG)

$\{F_i\}$ $K \times f_2$ ($f_2 = 2f_1$)

$\{F_a\}$ $1 \times f_2$

$\{F_h\}$ $1 \times f_2$

$\{F_c\}$ $1 \times f_2$

$\{F_b\}$ $1 \times 1\ Conv$

$\{F_o\}$ $1 \times f_{out}$

$\oplus$ *Concatenation*

S   *Sum*

E_S *Element-wise Sum*

A   *Attention*

$\odot$ *Element-to-Row Multiplication*

$\odot$ *Element-wise Multiplication*

p_k

Kernel position S_j

p_i

$S_o = p_i$

Point features p_k $K \times (3 + f_{in})$

Kernel weights W_n ($m \times f_{in} \times f_{out}$)

Outputs ($K \times (3 + f_1)$)

Summation ($1 \times f_{out}$)

Correlation function $C(s_j, p_k, p_i)$