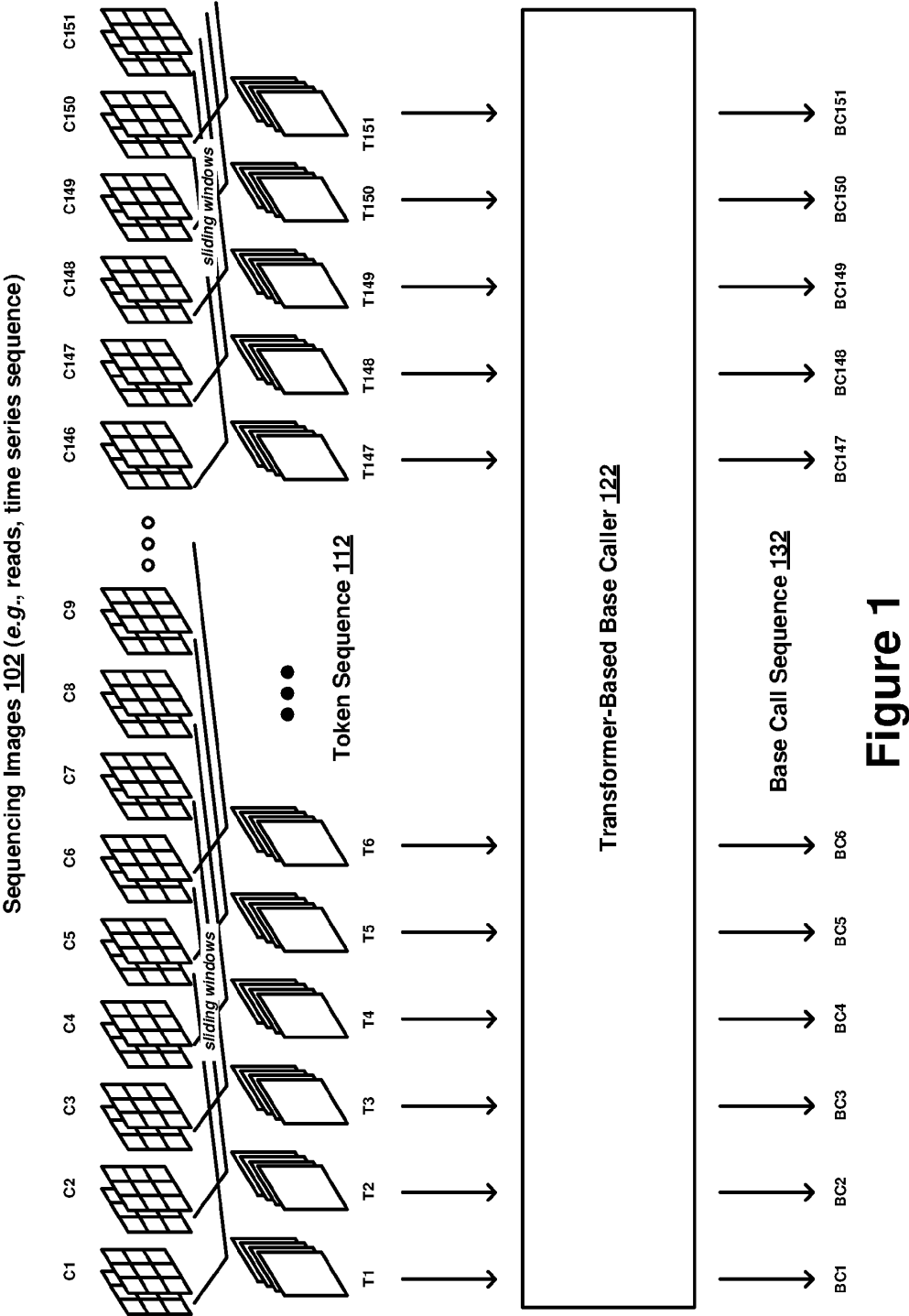




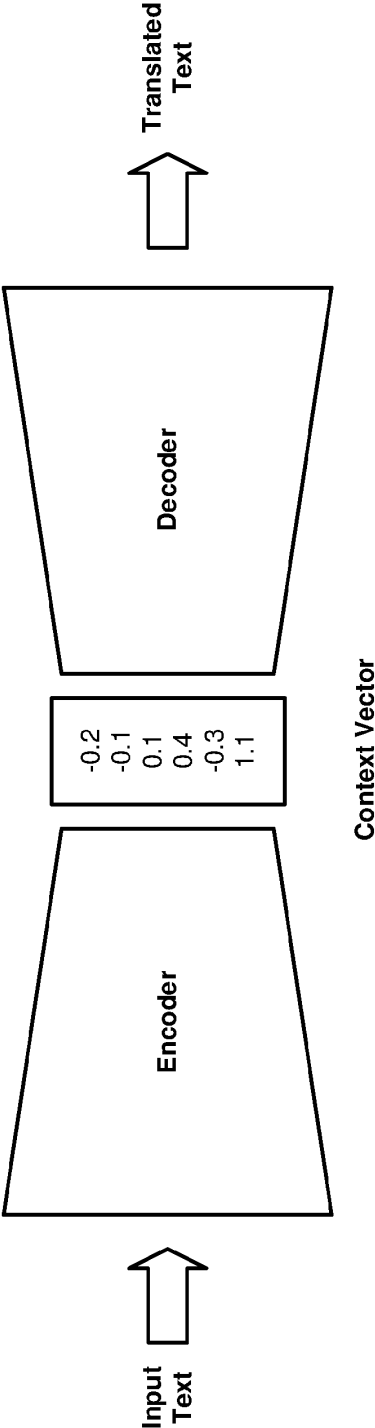


Figure 2

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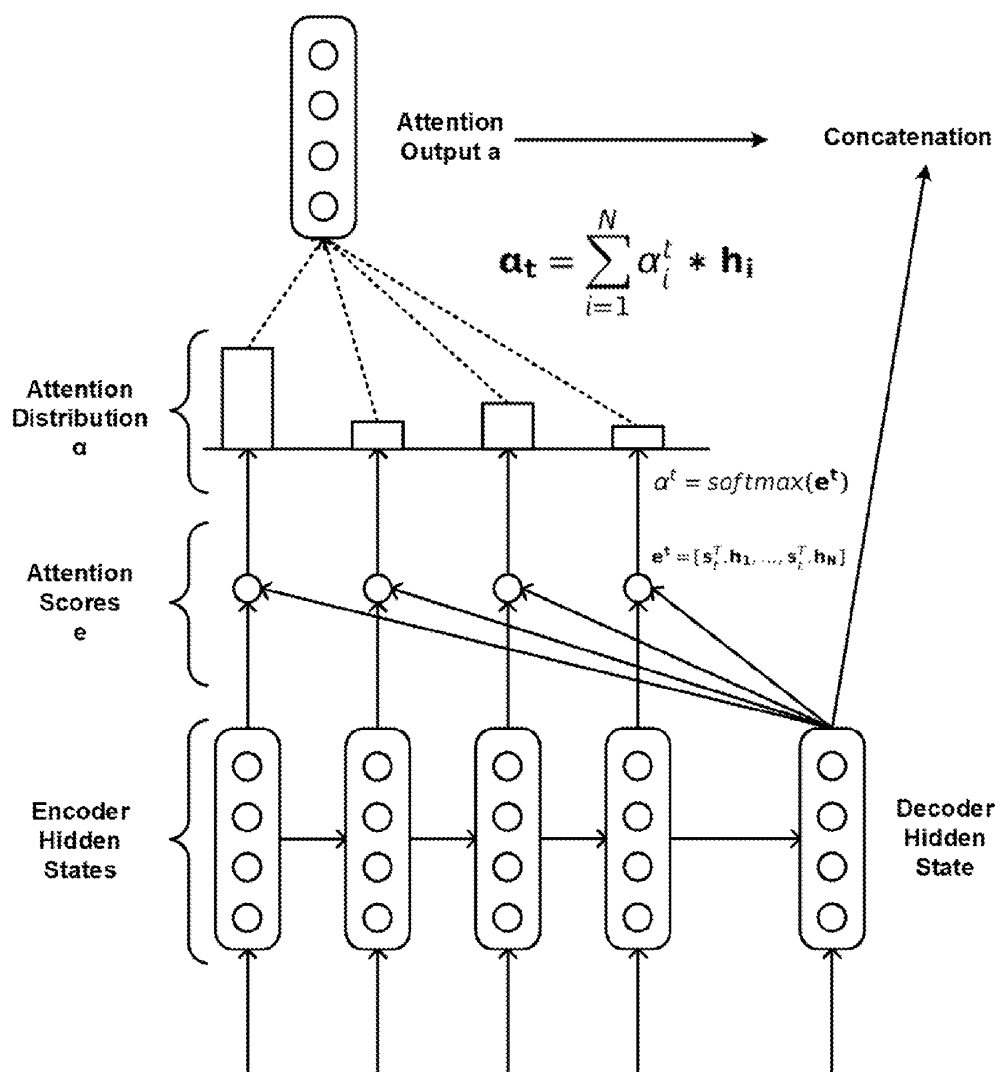
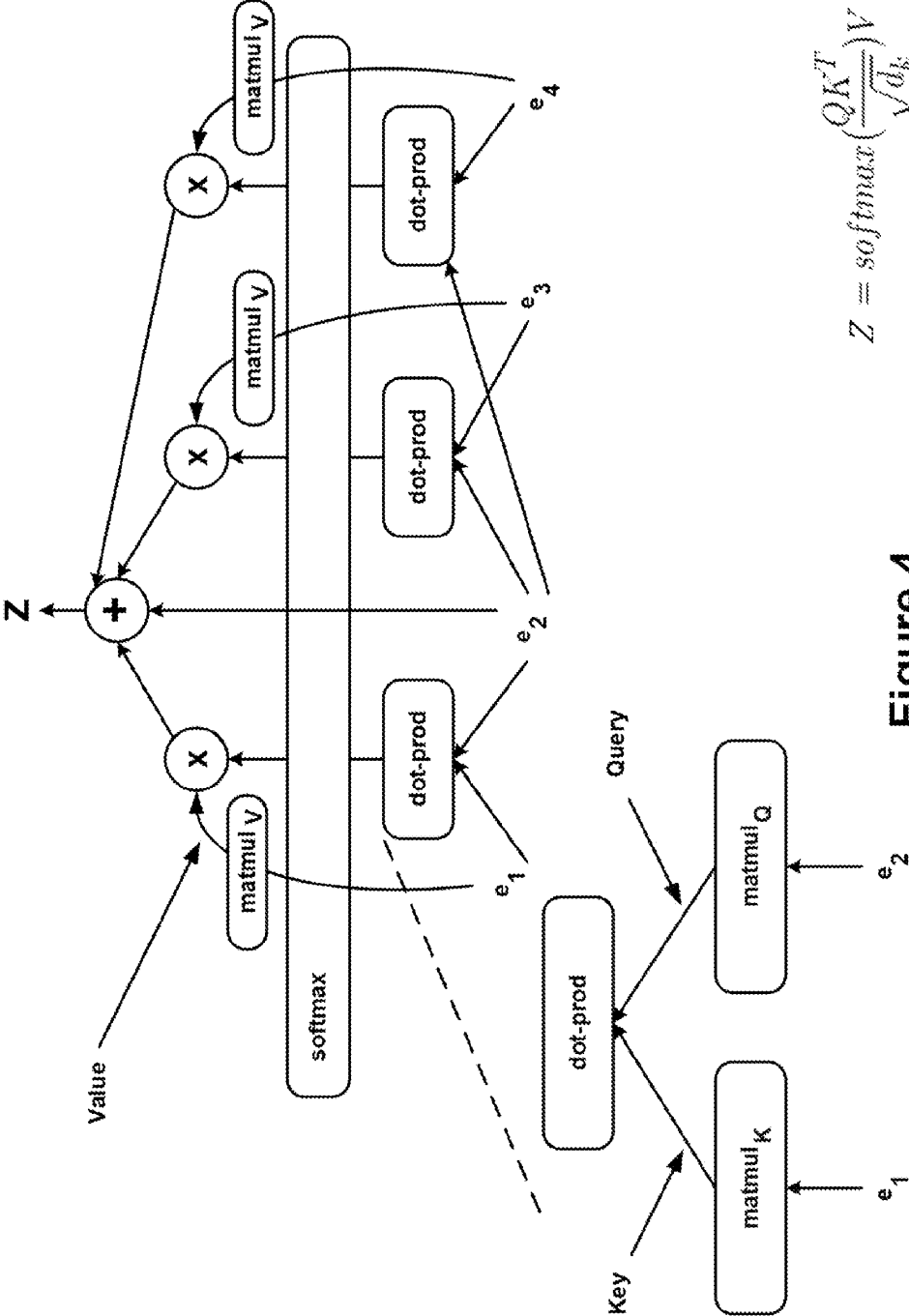


Figure 3



$$Z = softmax\left(\frac{QK^T}{\sqrt{d_k}}\right)V$$

Figure 4

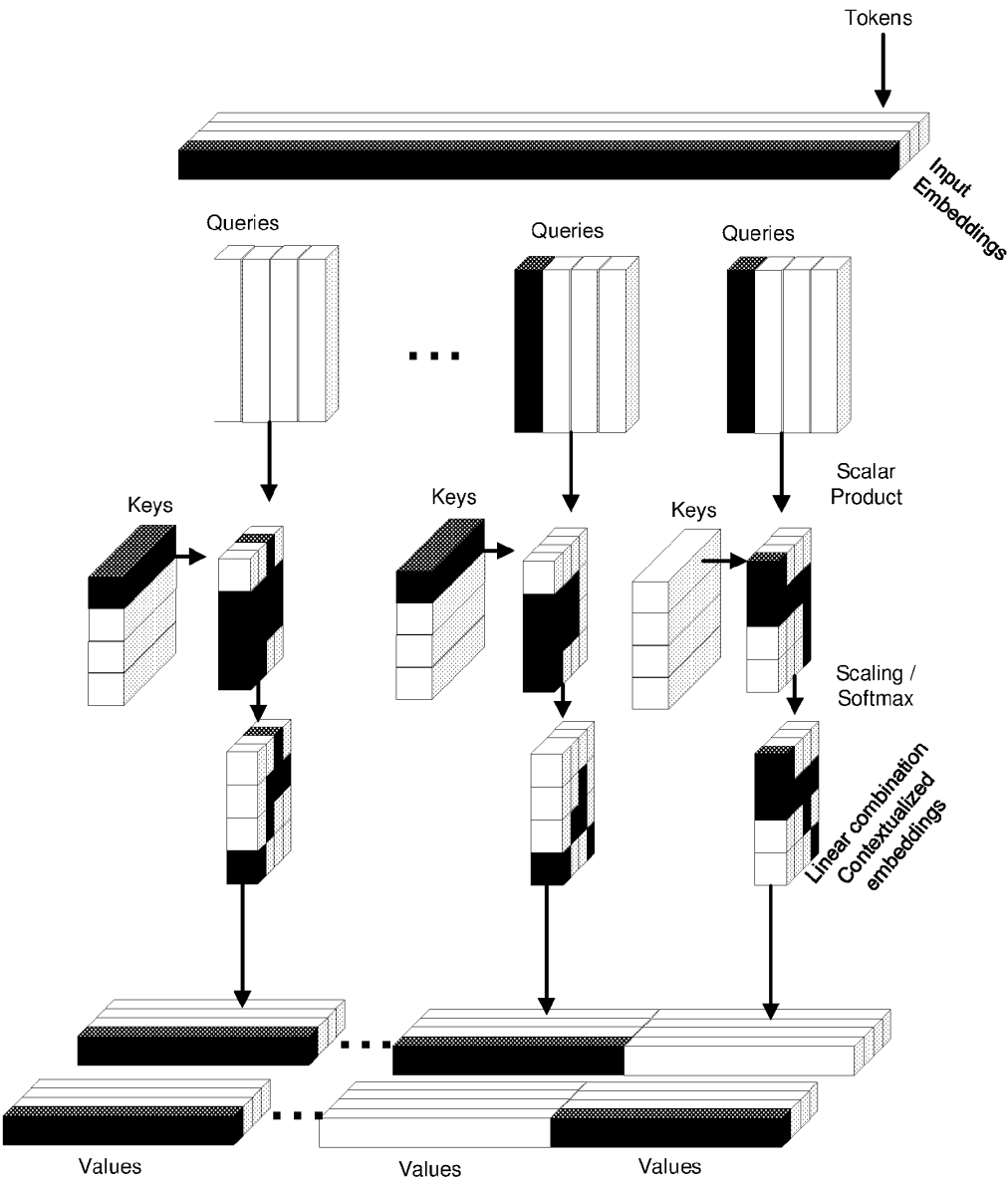


Figure 5

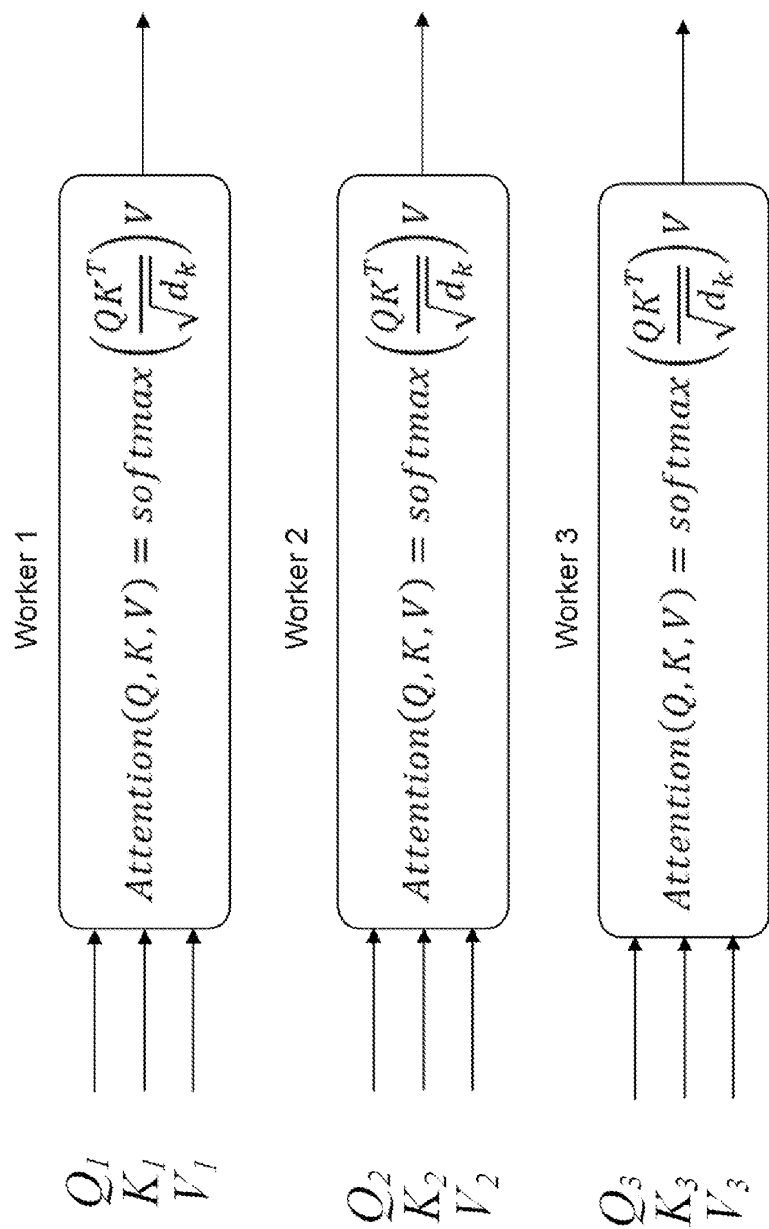


Figure 6

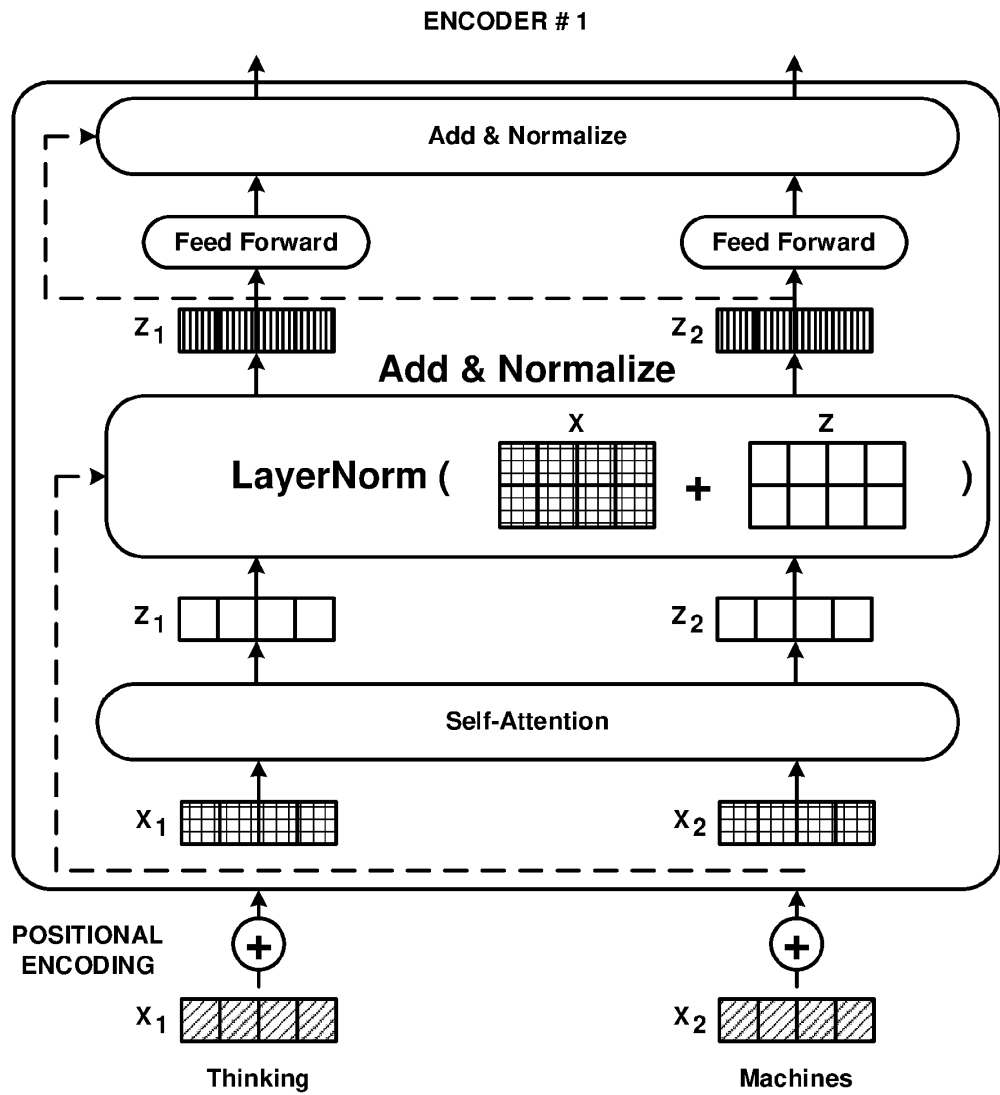
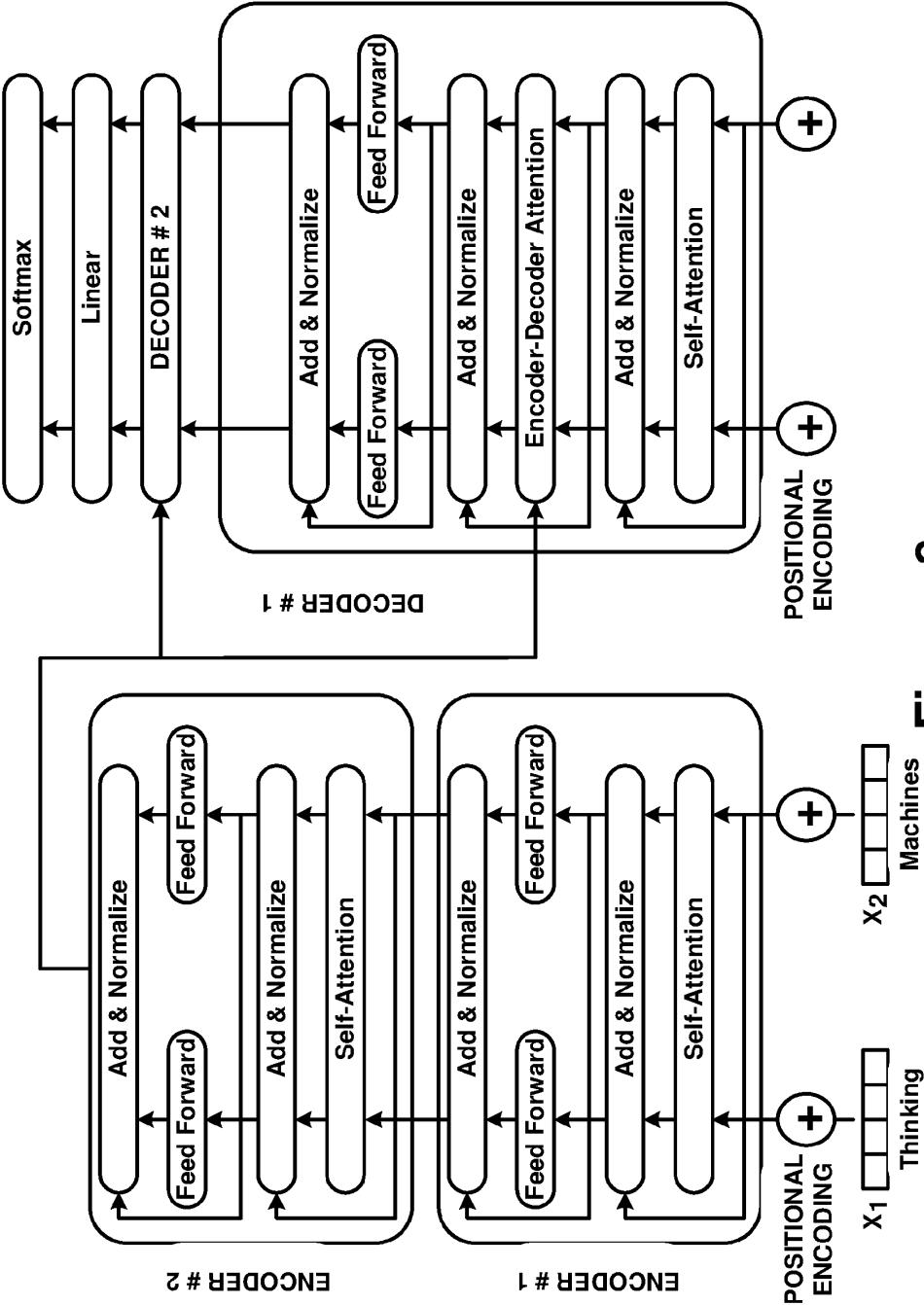


Figure 7



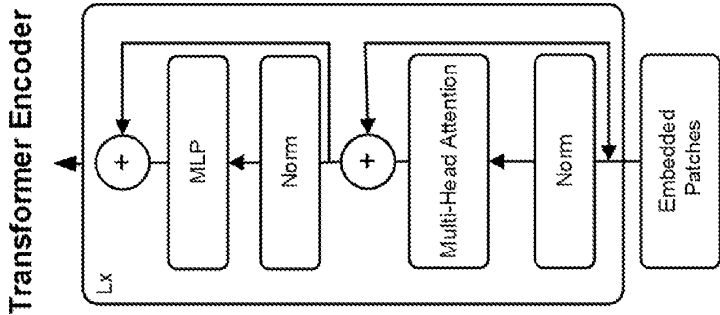


Figure 9B

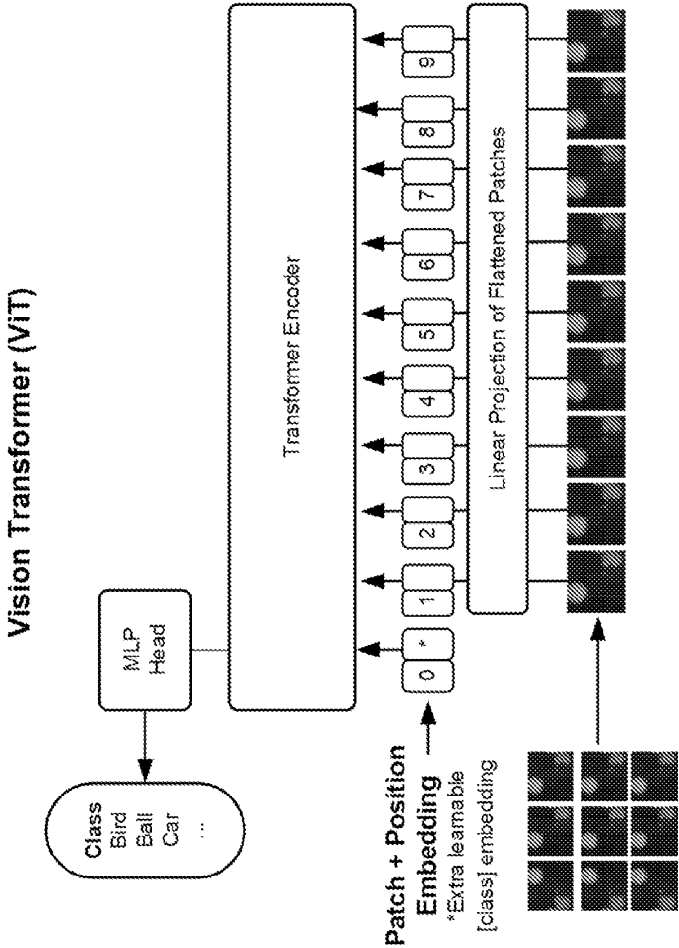


Figure 9A

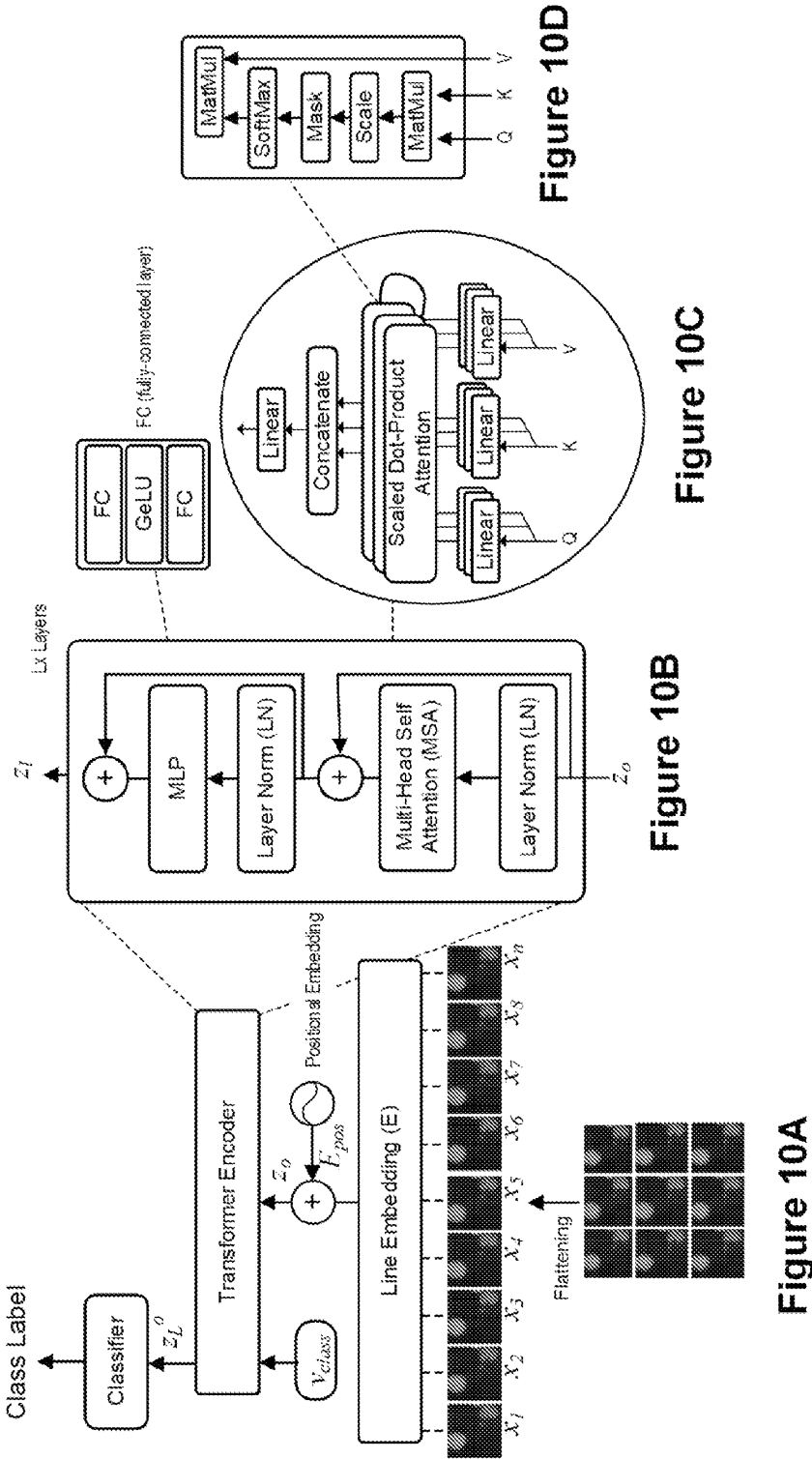


Figure 10D

Figure 10C

Figure 10B

Figure 10A

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```
batch_size = tf.shape(x)[0]
x = self.rescale(x)
patches = self.extract_patches(x)
x = self.patch_proj(patches)

class_emb = tf.broadcast_to(
    self.class_emb, [batch_size, 1, self.d_model]
)
x = tf.concat([class_emb, x], axis=1)
x = x + self.pos_emb

for layer in self.enc_layers:
    x = layer(x, training)

return self.mlp_head(x[:, 0])
```

Figure 11

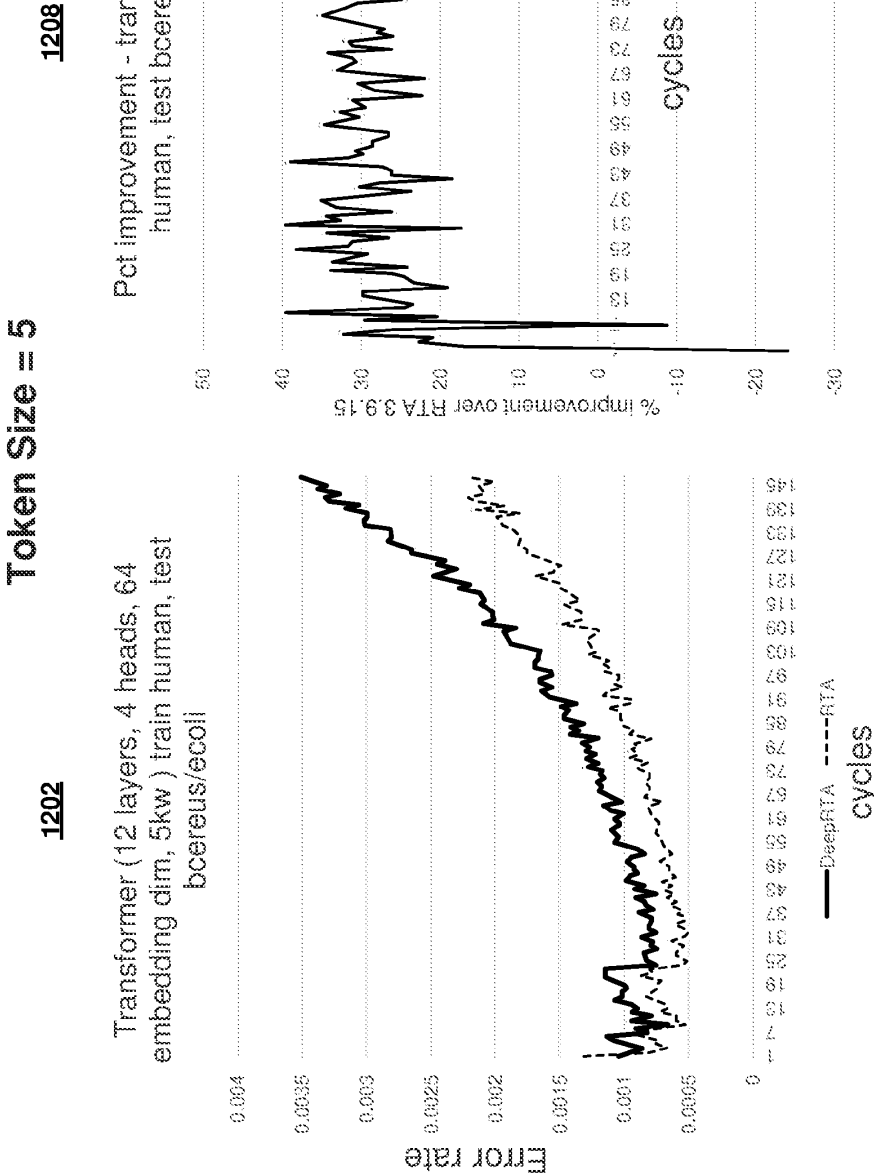


Figure 12

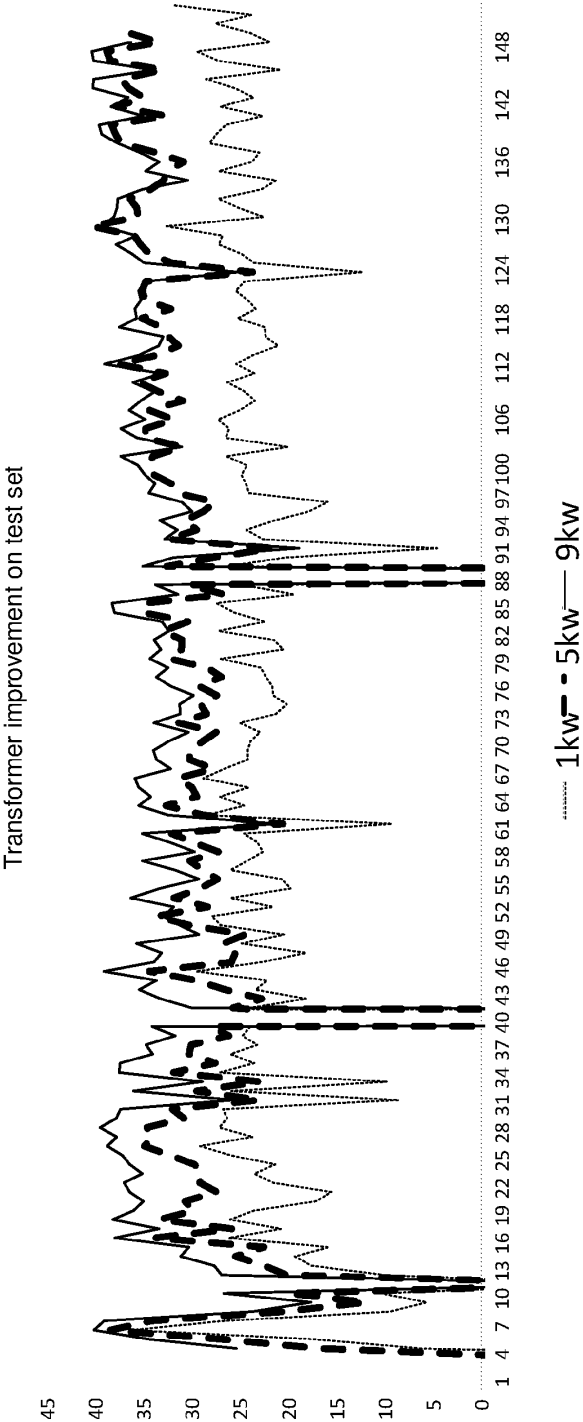


Figure 13

Training schedule (~70 epochs likely needed)

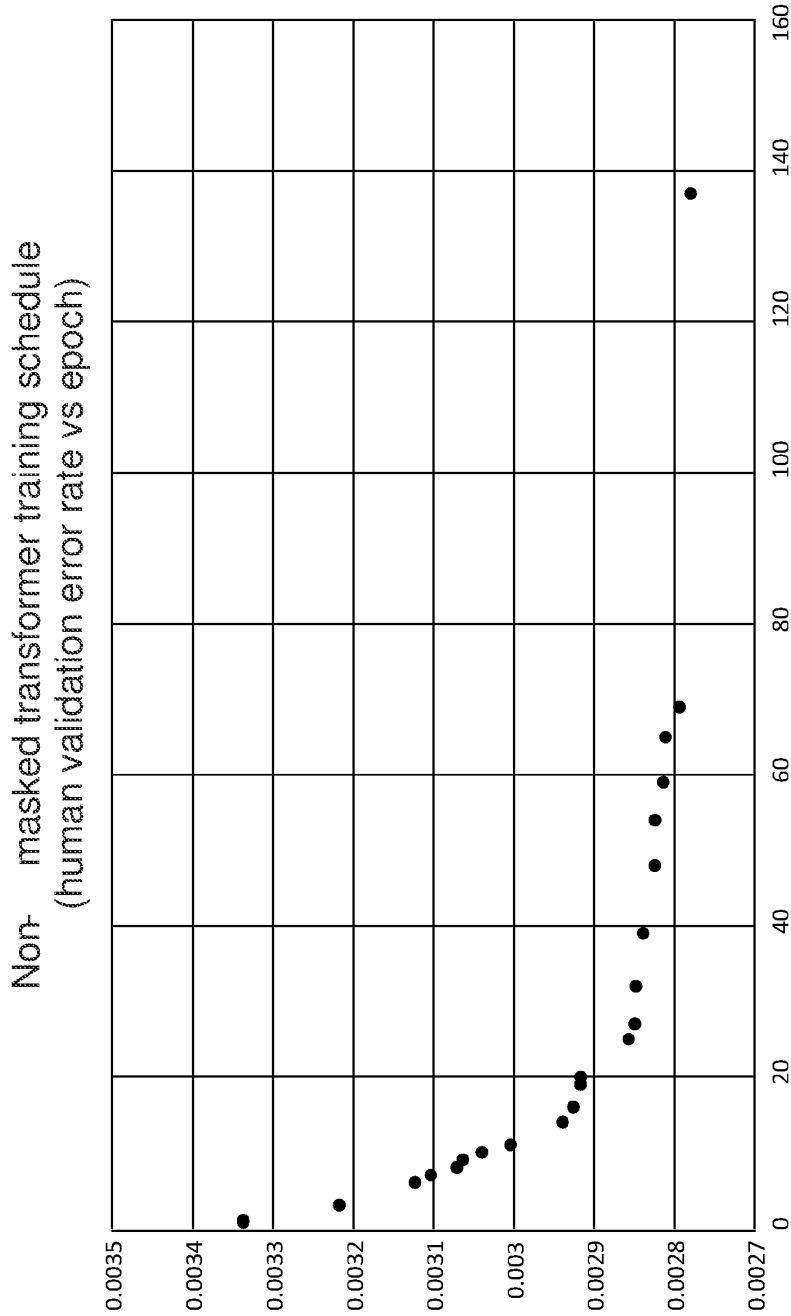


Figure 14

Learned positional and token embeddings

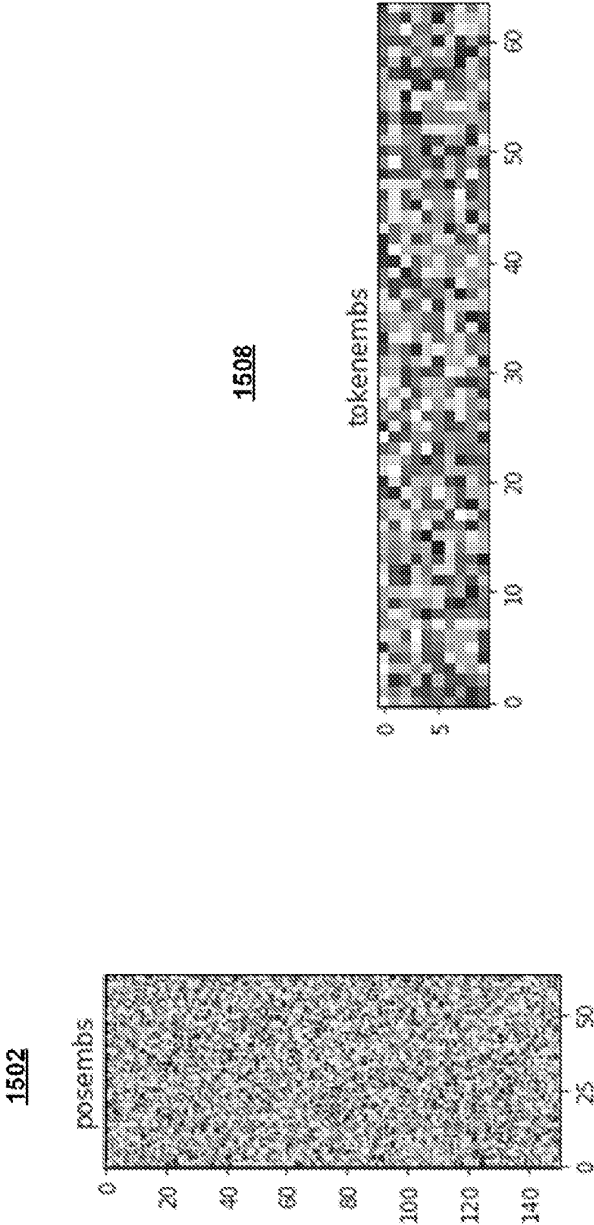


Figure 15

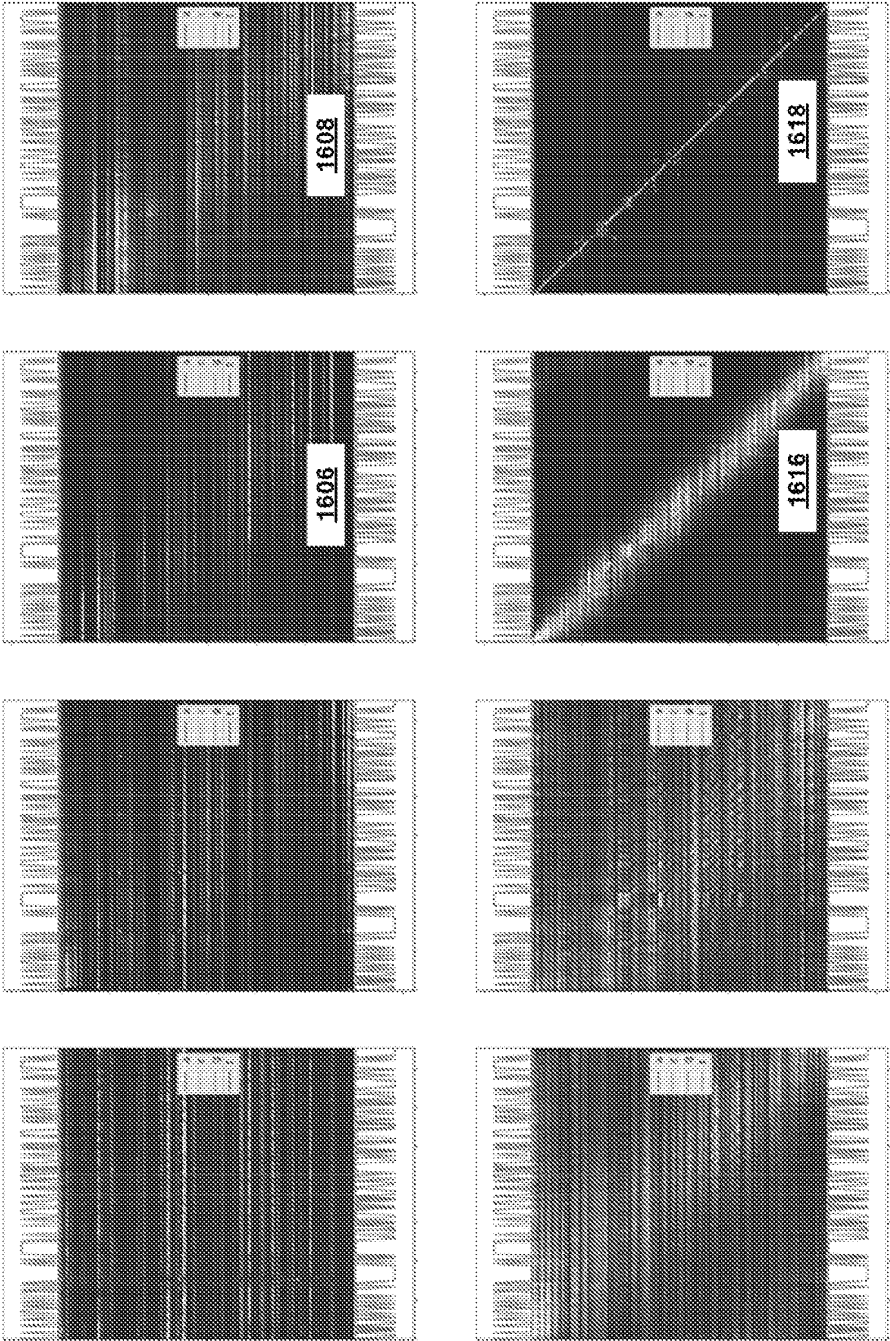
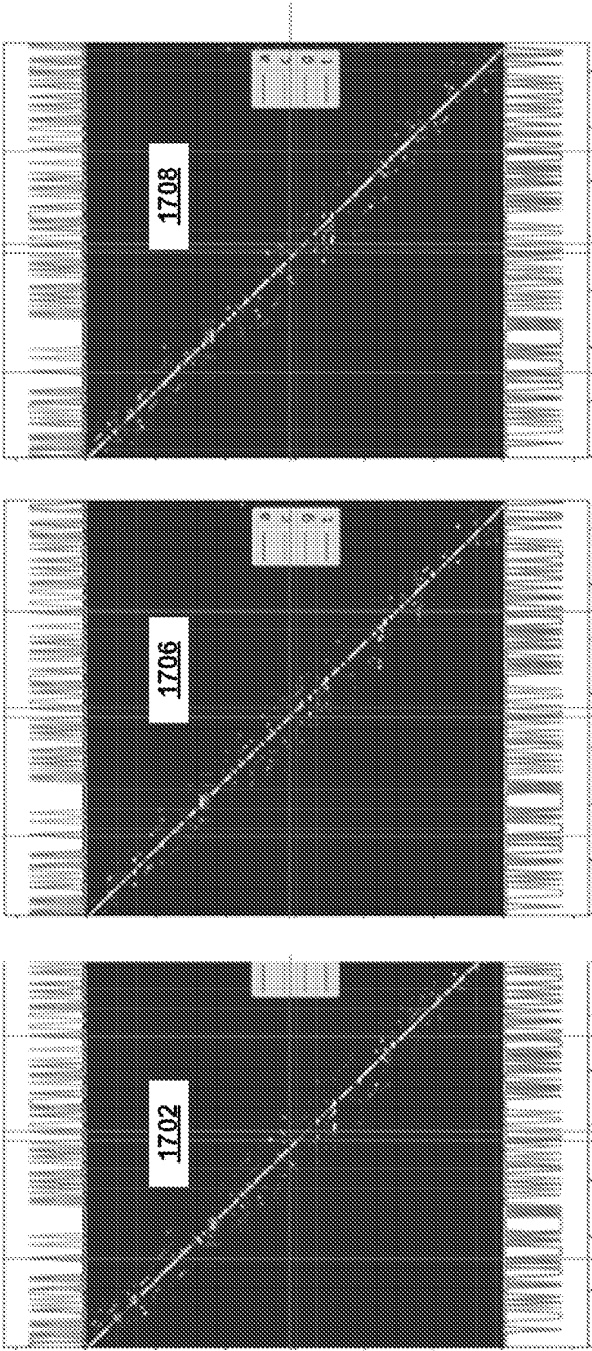


Figure 16



46

48

49

Figure 17

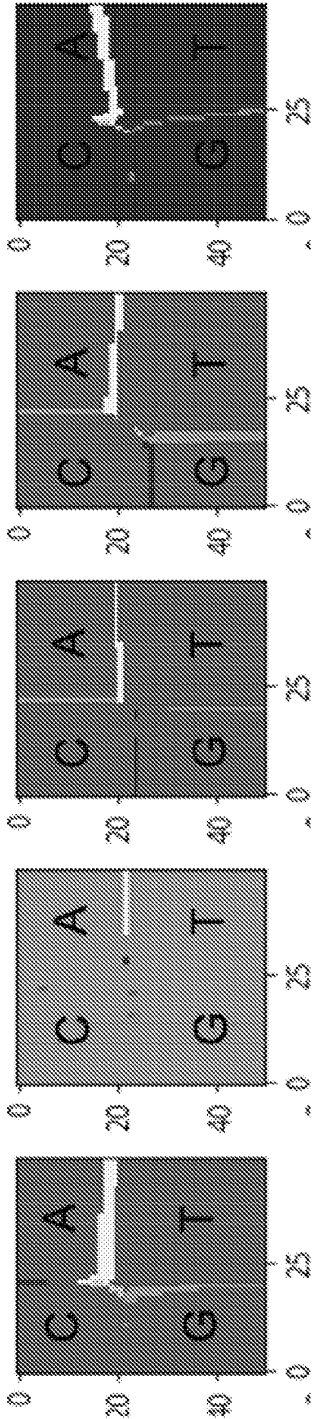
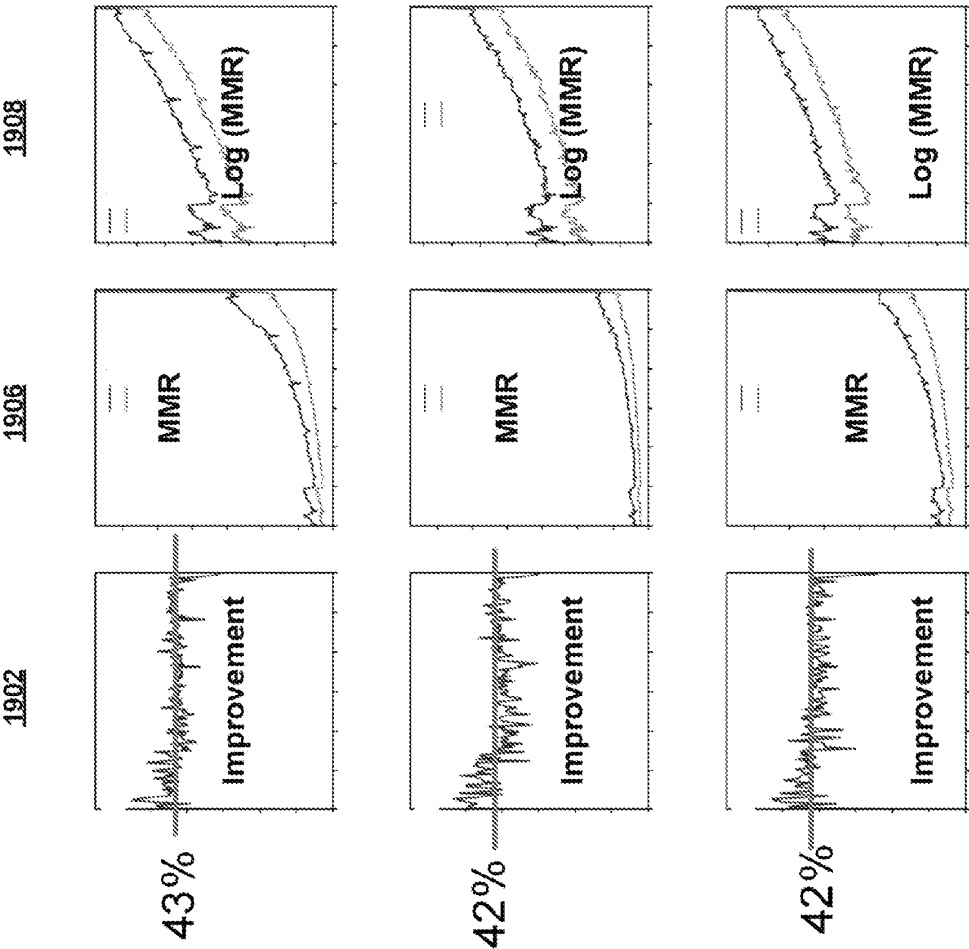
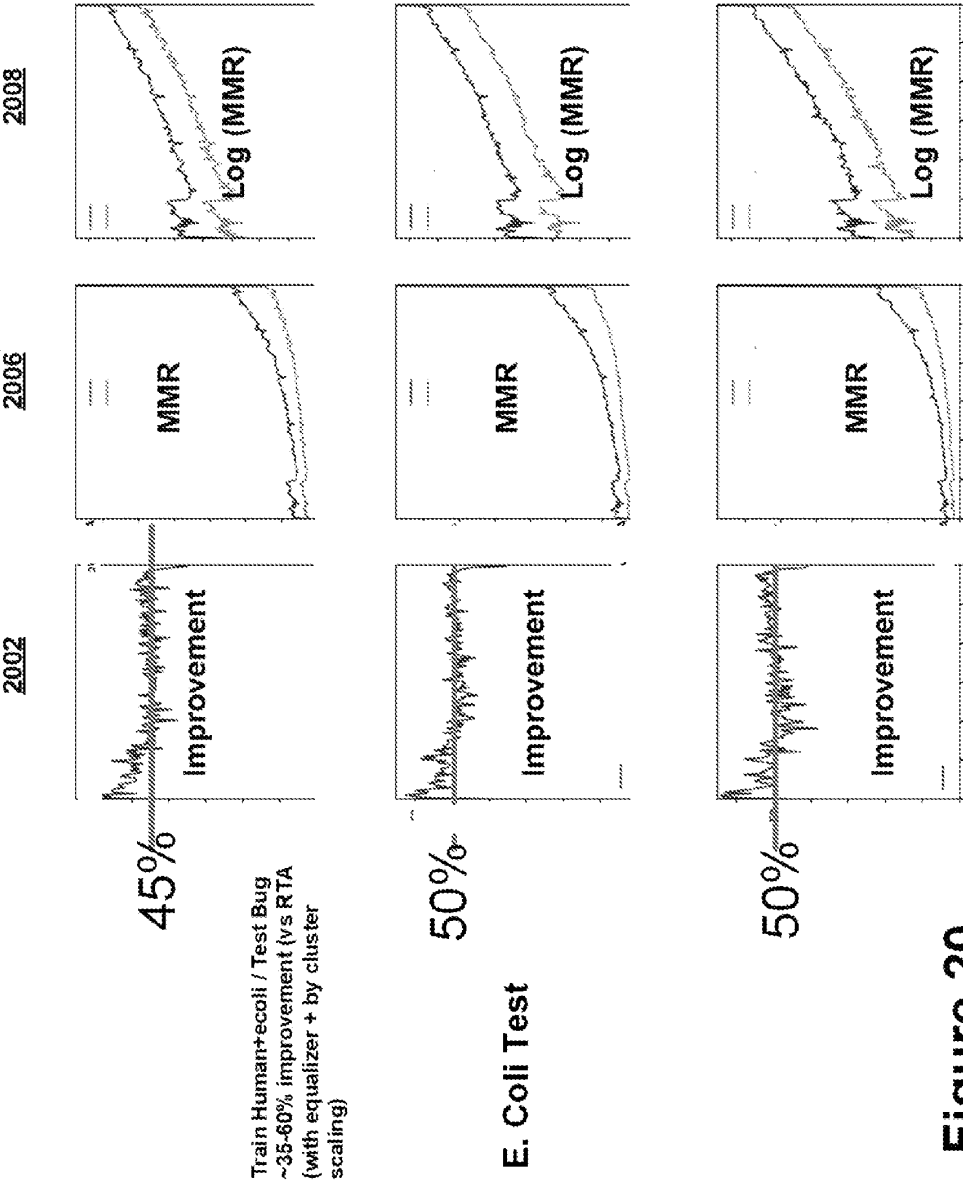


Figure 18



B. Cereus Test

Figure 19



Train Bug / Test Human
~30-35% improvement (vs RTA)
transformer_bug_FCI_4h2l128d9kw train ecoli/bcereus test human

Chart Area
50

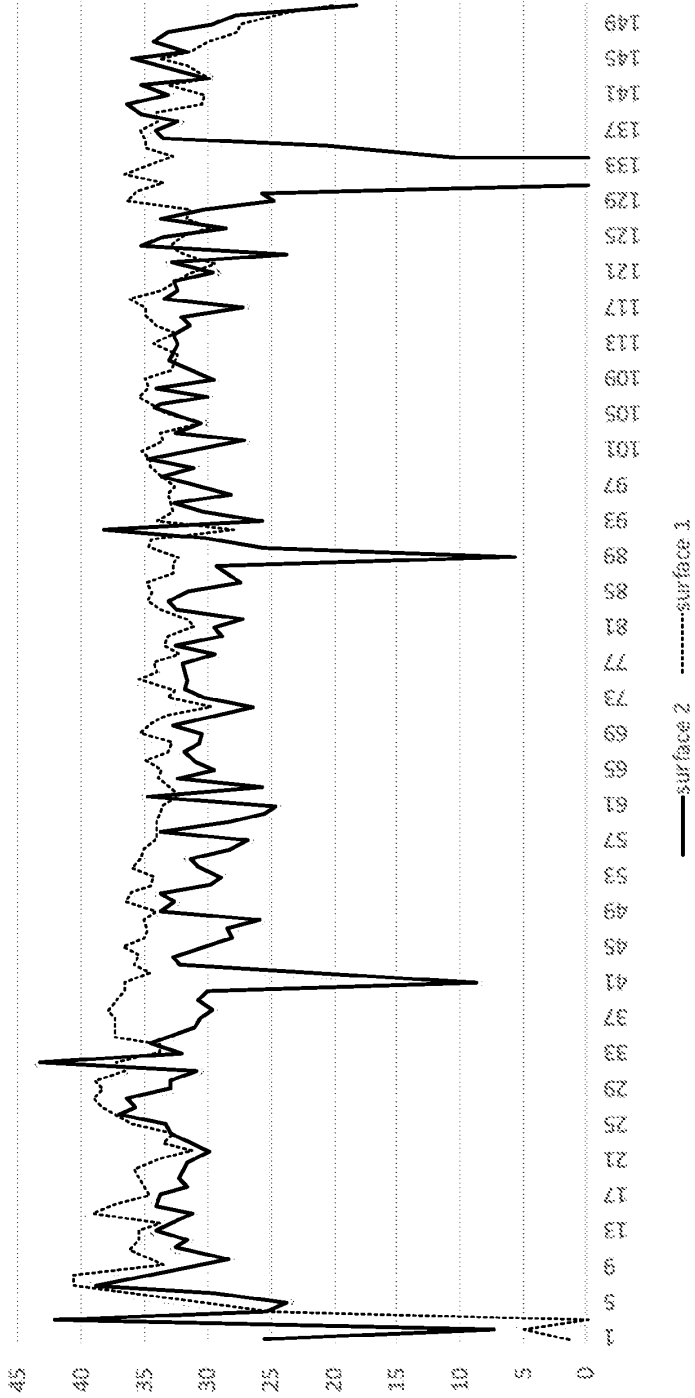


Figure 21

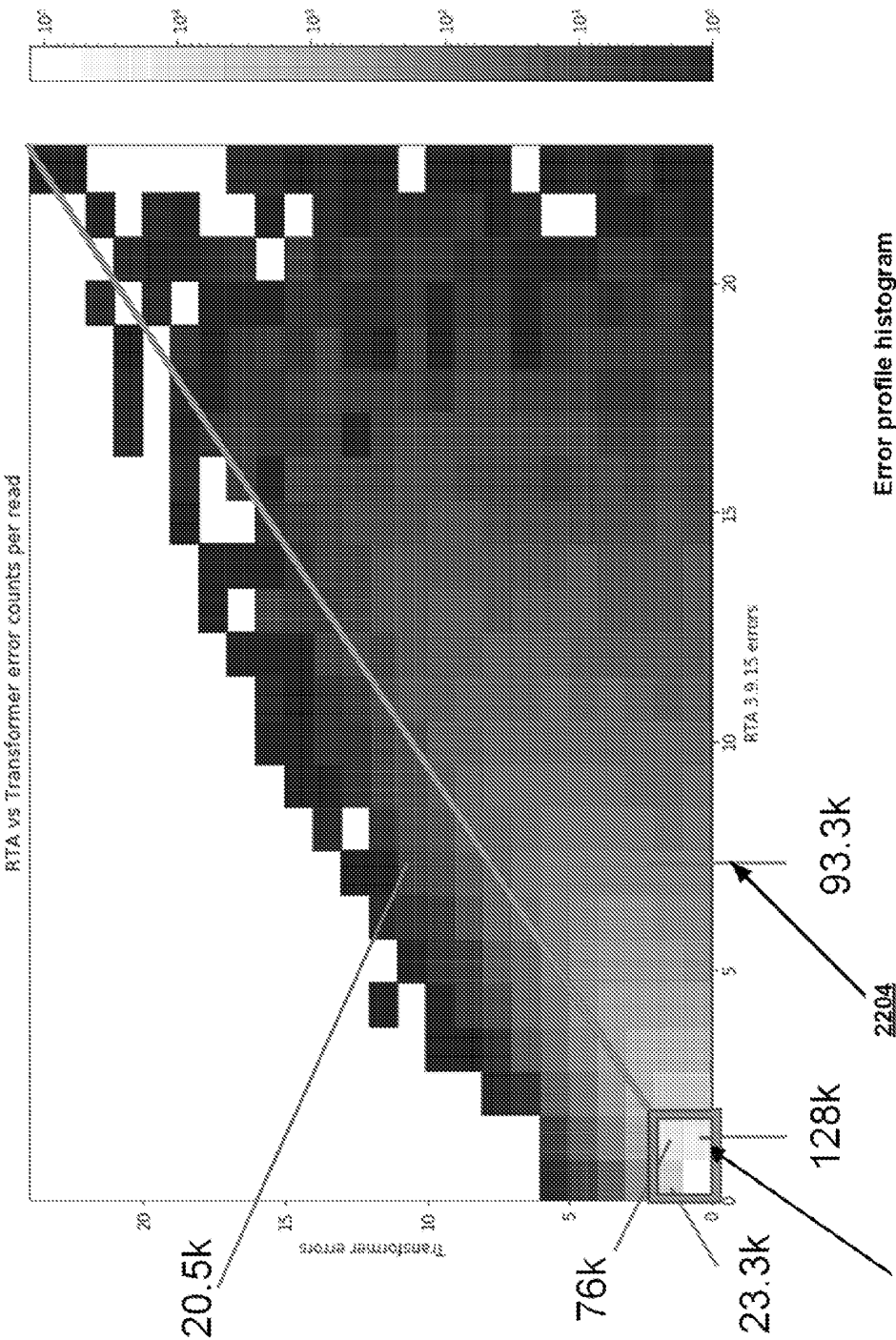


Figure 22

Improvement on difficult reads

Read type	Pct improvement (% over RTA)	Pct of all seq
Overall	34.7%	
Homopolymers(9+) (4.1% of reads)	39.37%	4.1%
Homopolymer (15+)	44.2%	
Homopolymer (20+)	46%	
gquads	32.9%	23.6% (search query too sensitive– iow we don't know unless we can select gquads better)
“ cquads”	34.3%	27.7% (search query too sensitive– iow we don't know unless we can select gquads better)

Figure 23

Example hp sequence (569)

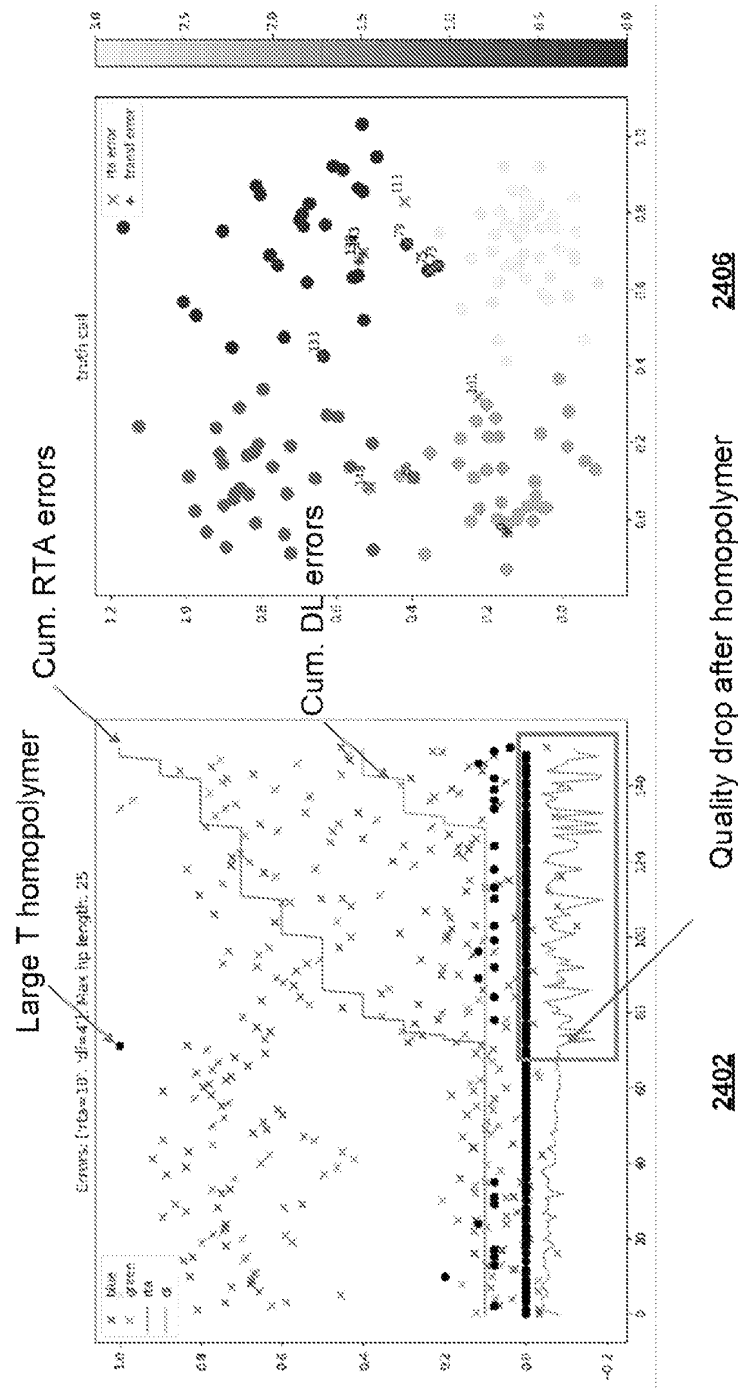
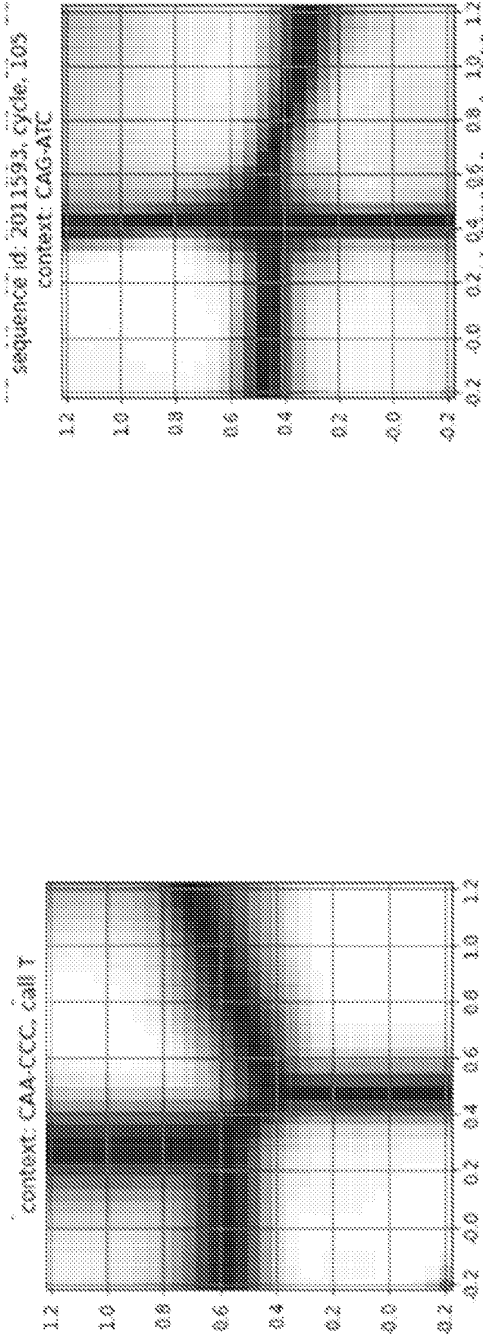


Figure 24

Transformer-Based Base Caller adjusts its decision boundaries based on the context of the current sequencing cycle being base called



AAX Decision boundaries

AGX Decision boundaries

2502

X is the current sequencing cycle being base called

2506

Figure 25

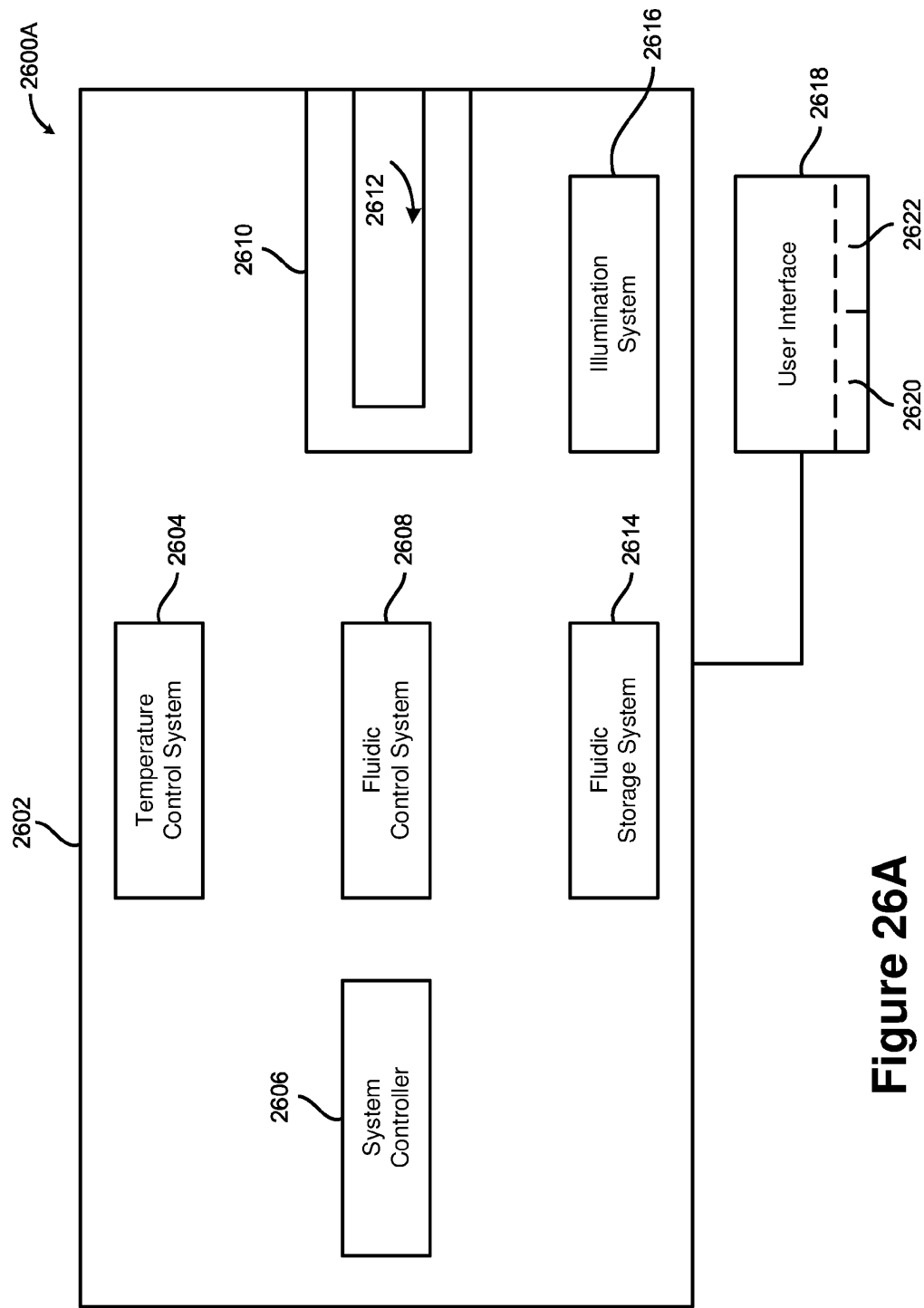


Figure 26A

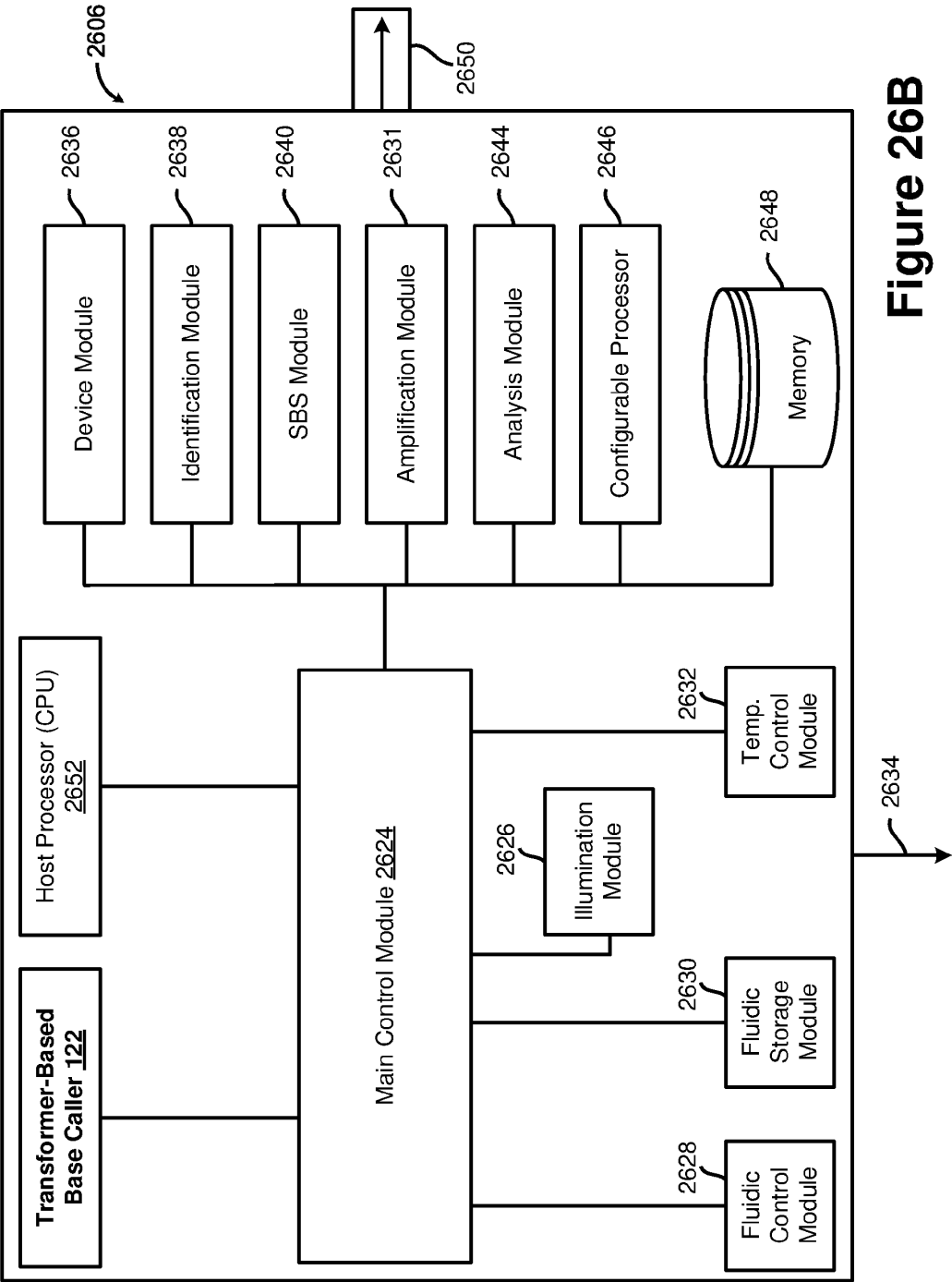


Figure 26B

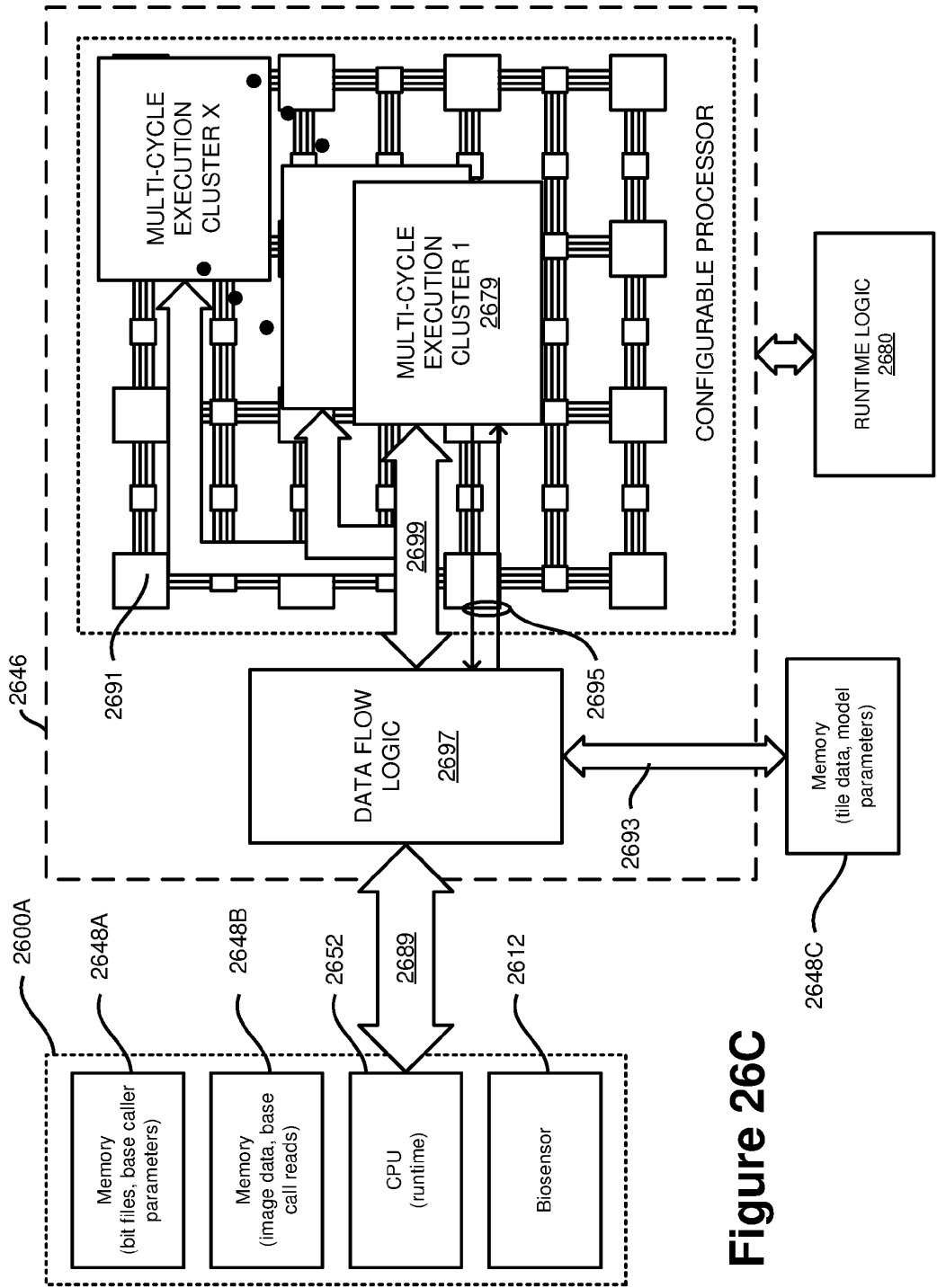


Figure 26C

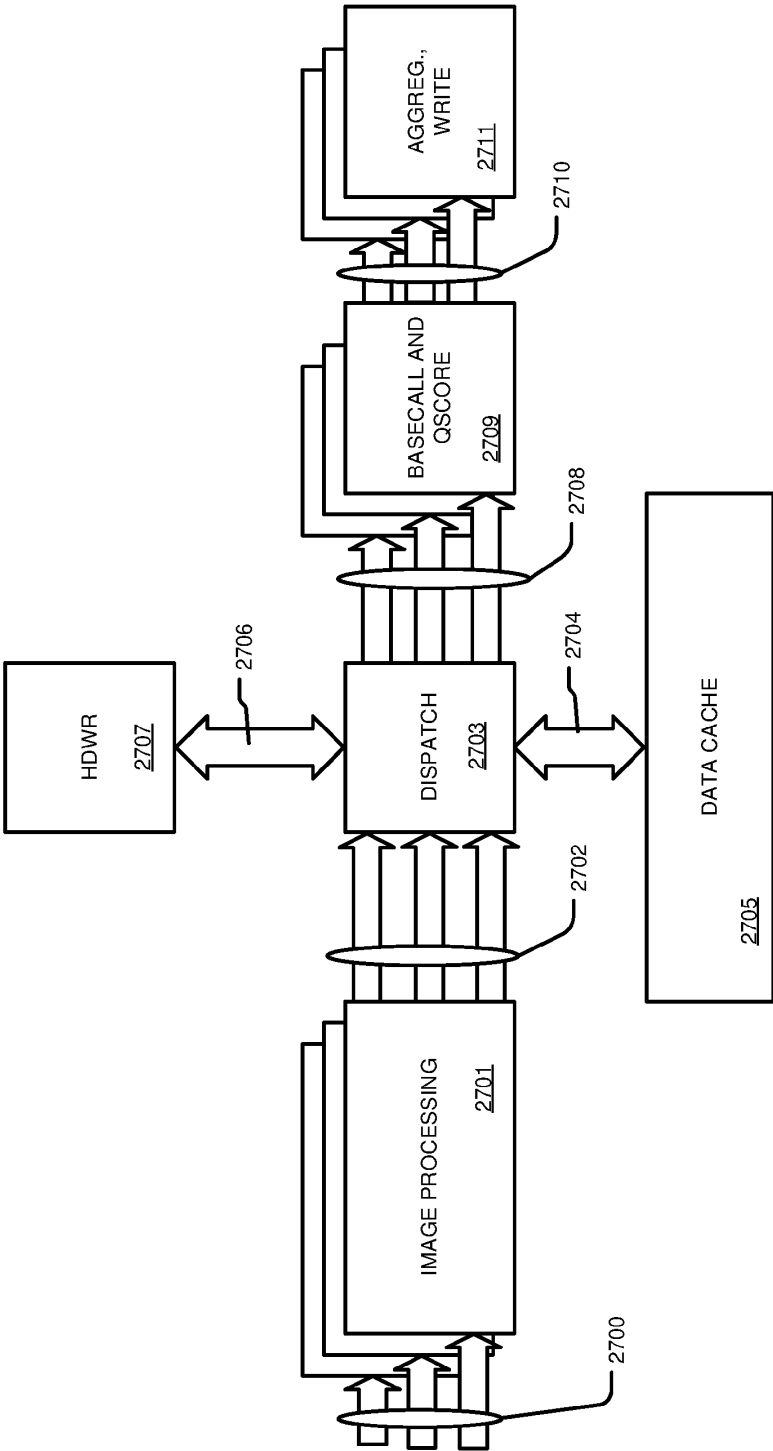


Figure 27A

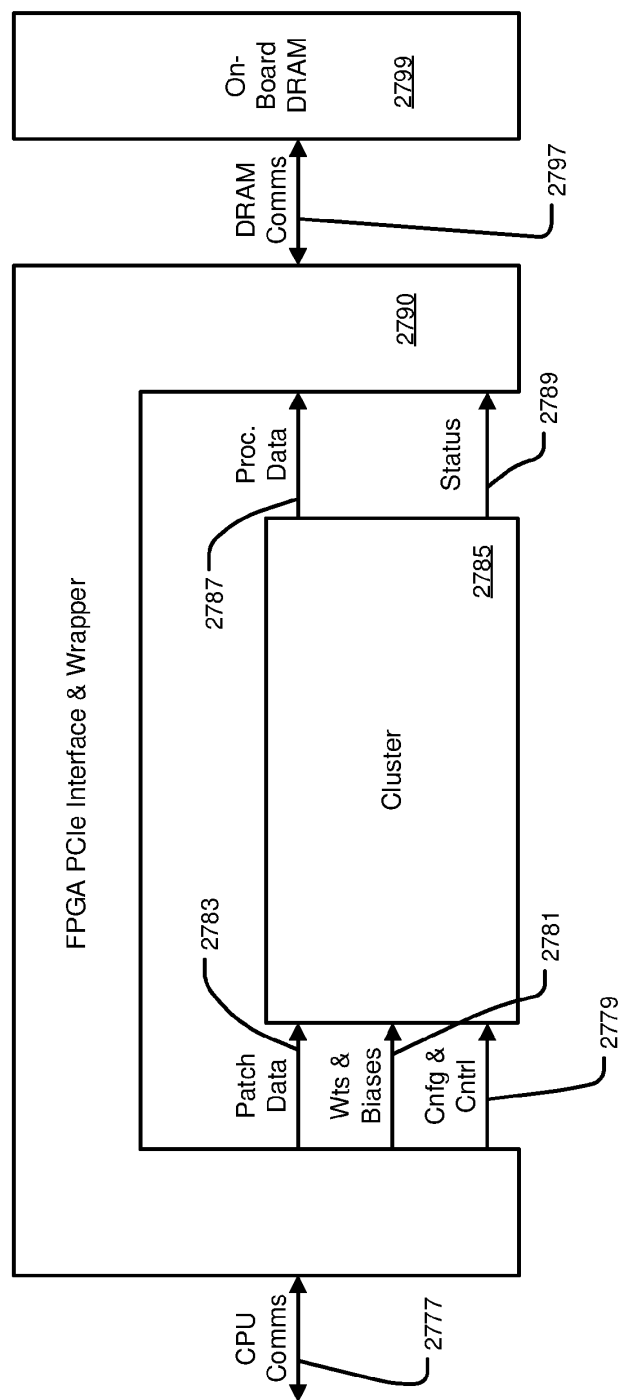


Figure 27B