Think in Cloud UCLOUD

UISEE驭势

2018 THINK IN CLOUD BEIJING

嵌入式设备上的实时深度学习方法实践

潘争

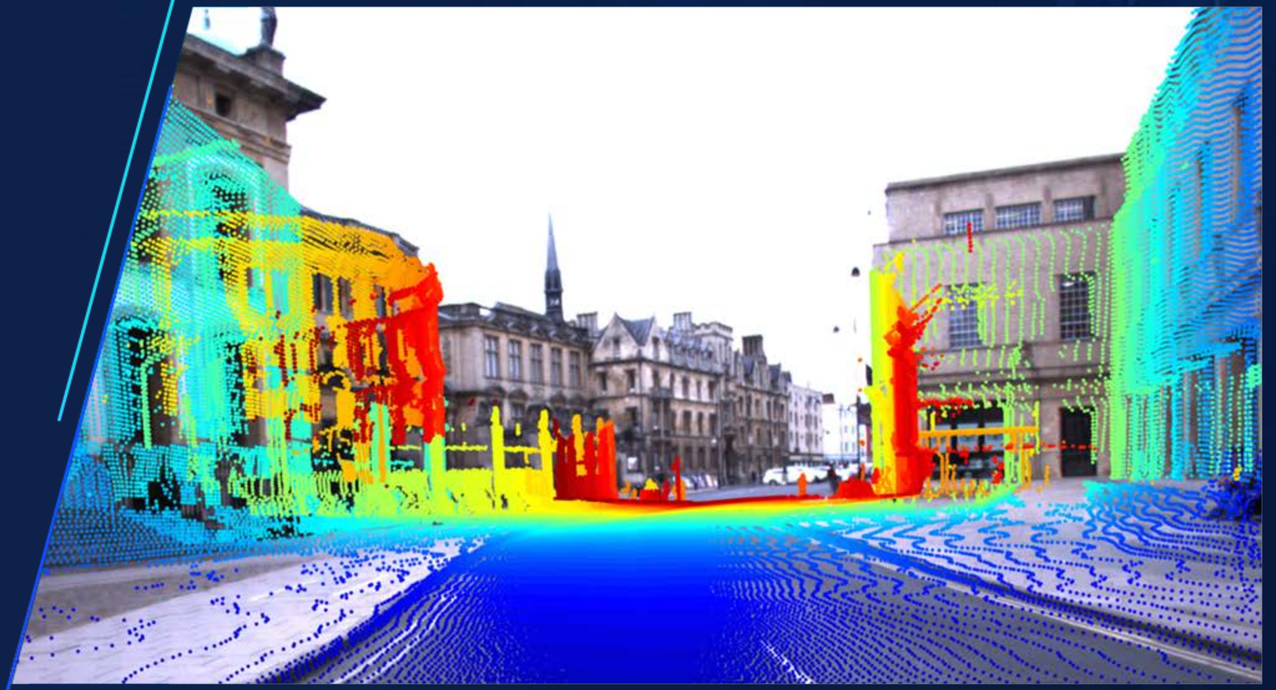
目录

01

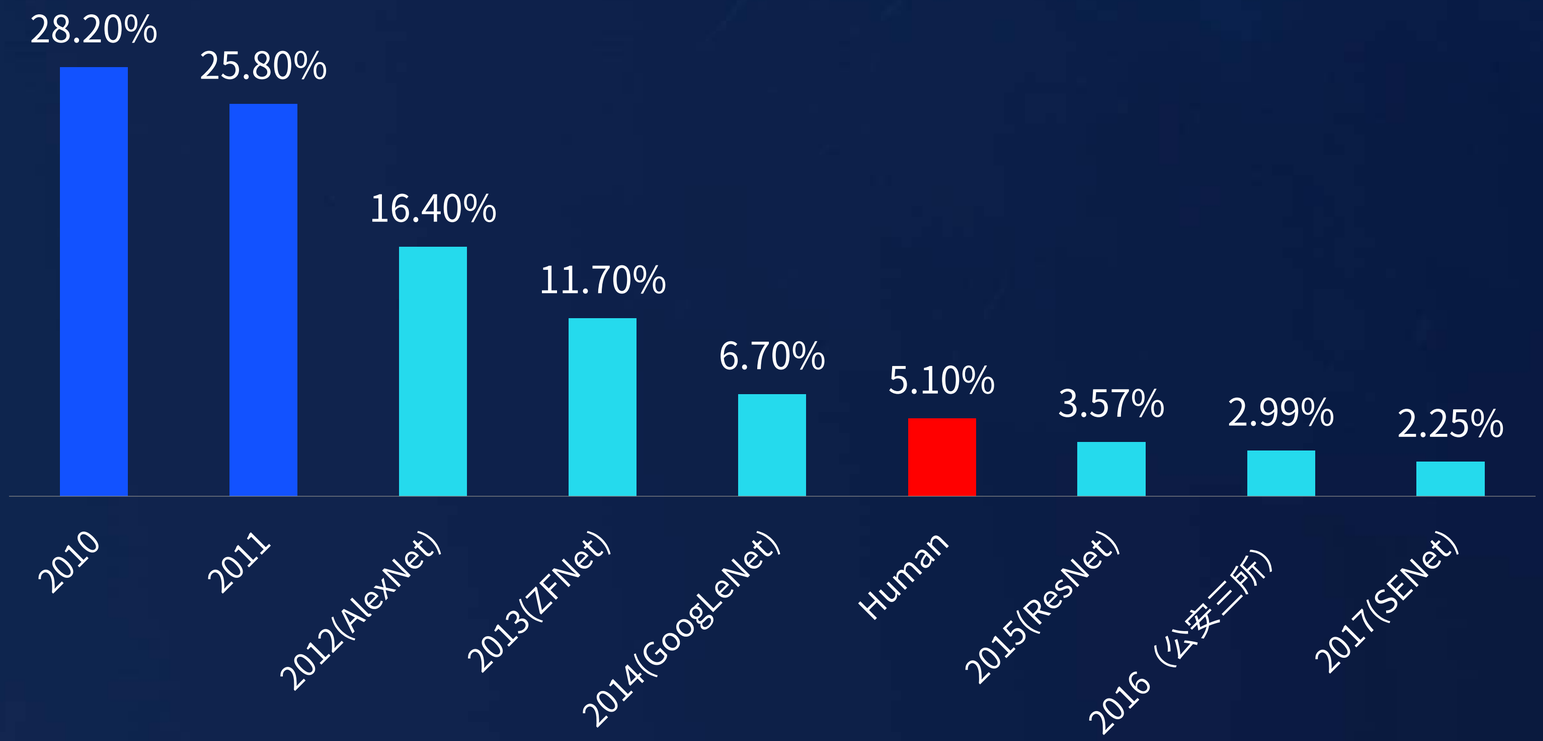
视觉感知的特点

视觉感知的特点

- 信息更丰富
- 视野更宽阔
- 基建更配合
- 硬件更便宜

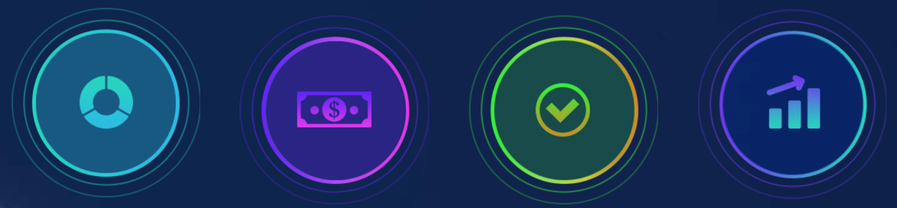


视觉识别算法飞速进步ImageNet Top-5错误率



视觉感知从demo到deploy

Demo

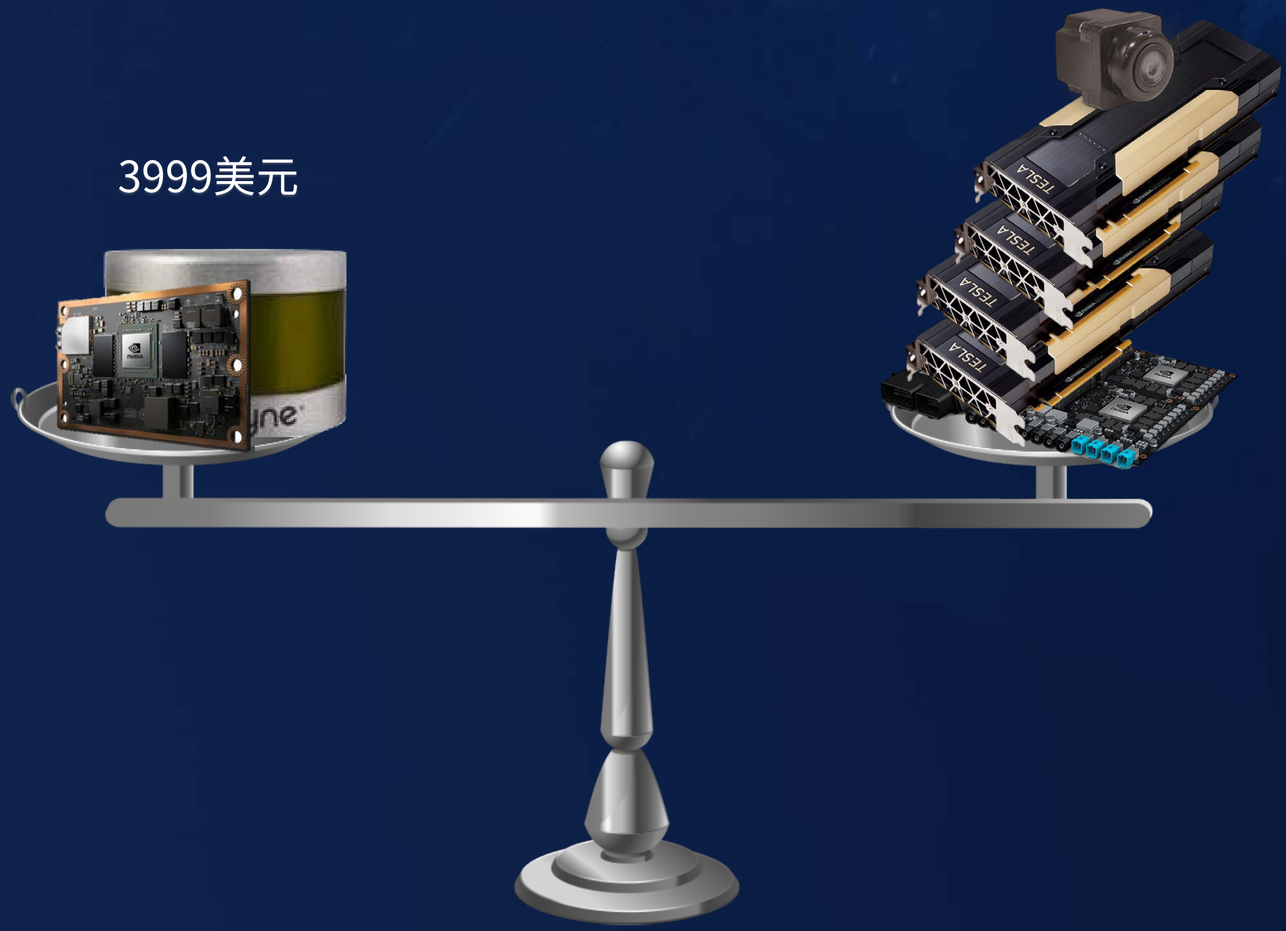


精度要高　不计成本　不管标准　不算功耗

Deploy

低成本　低功耗　合车规　实时性　精度用户满意

低成本?

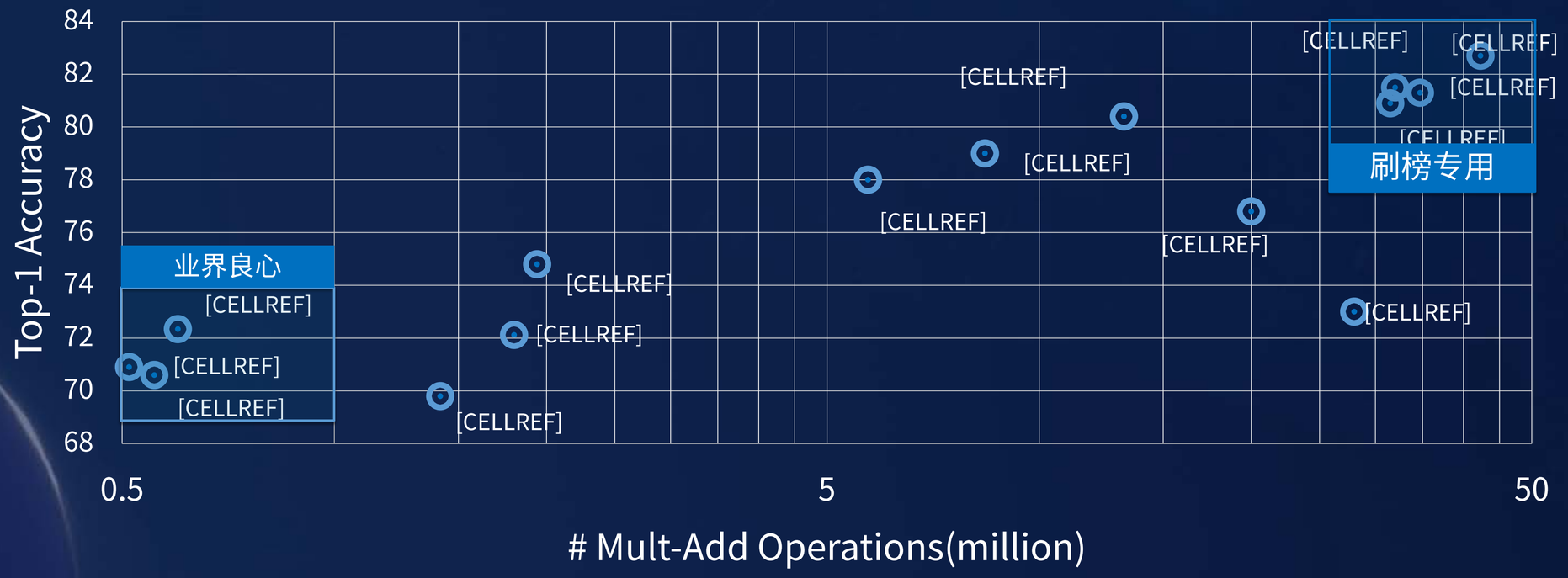


硬件更便宜

02

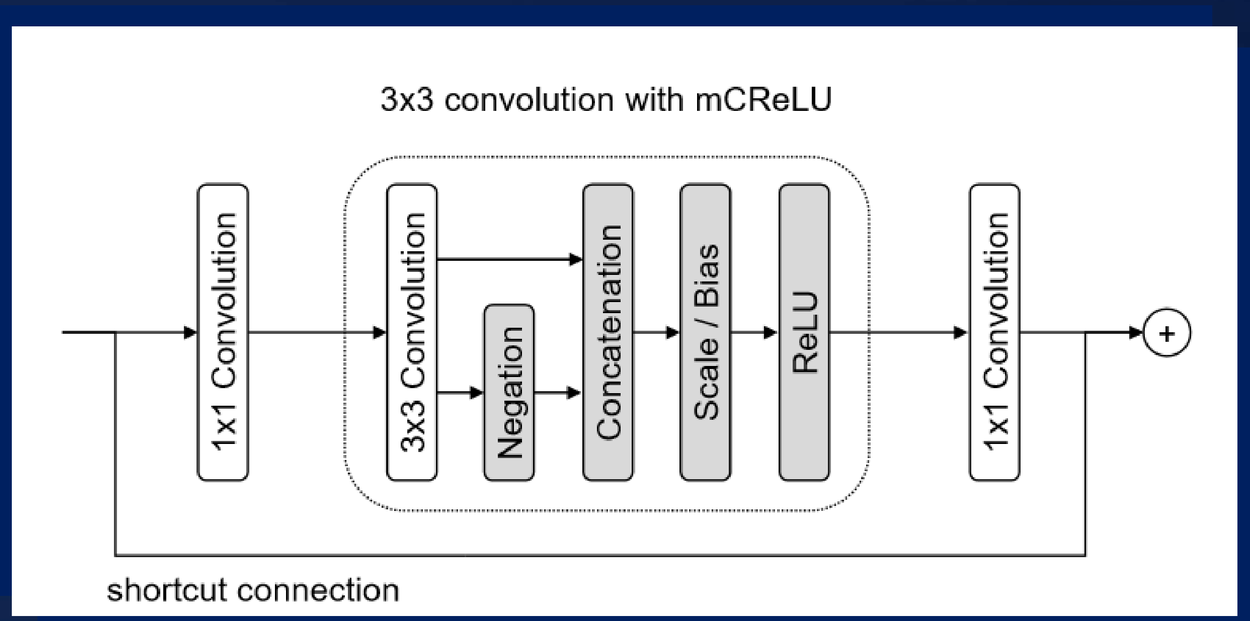
效率精度平衡的卷积网络

效率与精度的取舍


84
82
80
78
76
74
72
70
68
Top-1 Accuracy
0.5
5
50
Mult-Add Operations(million)
业界良心
刷榜专用
[CELLREF]

PVANet

Hong S, Roh B, Kim K H, et al. PVANet: Lightweight Deep Neural Networks for Real-time Object Detection. arXiv, 2016.

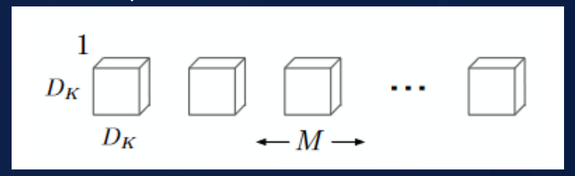


PVANet+fasterRCNN 物体检测

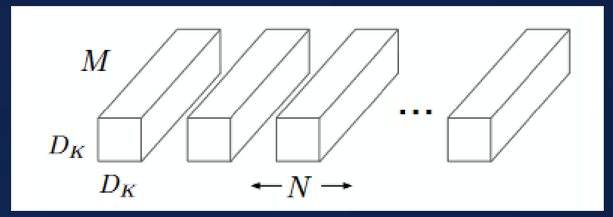
MobileNet

Howard A G, Zhu M, Chen B, et al. MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications. arXiv, 2017.

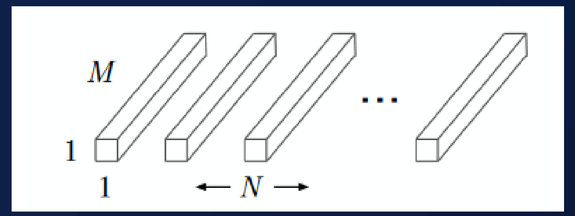
Depth wise convolution



Standard convolution



1x1 convolution



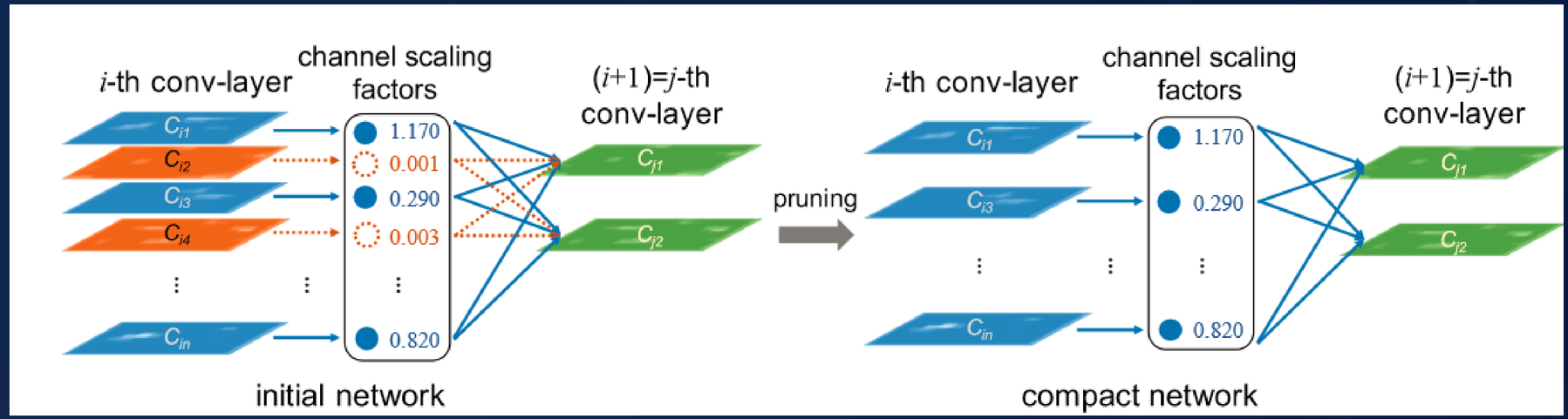
$$\frac{\text{dw conv} + \text{1x1 conv}}{\text{std. conv}} = \frac{1}{D_k^2} + \frac{1}{N}$$

03

卷积网络的压缩

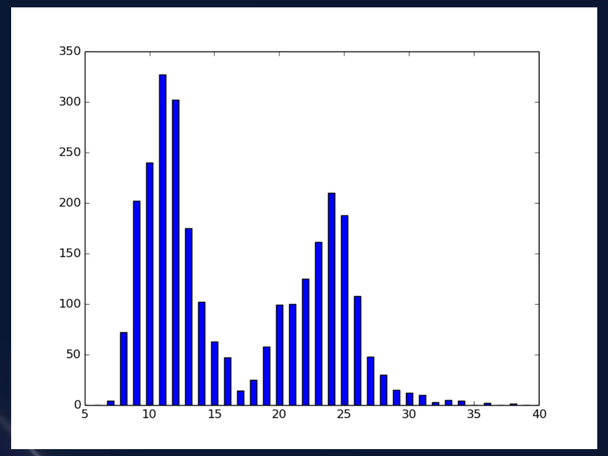
Network slimming

Liu Z, Li J, Shen Z, et al. Learning Efficient Convolutional Networks through Network Slimming. arXiv, 2017.

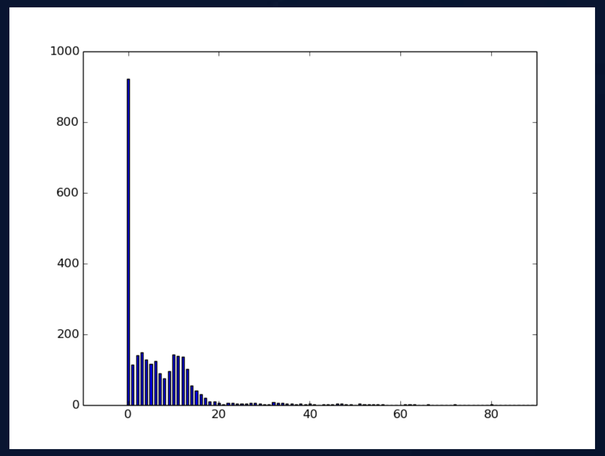


$$L(w) = \sum_i l(f(x_i, w), y_i) + \lambda \sum_{\gamma \in \Gamma} \|\gamma\|_1$$

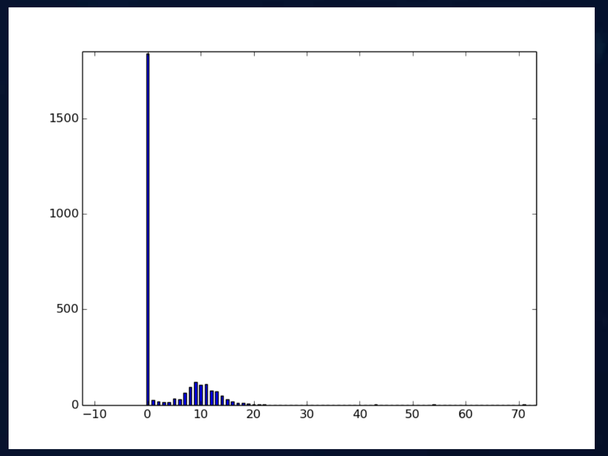
网络参数稀疏化效果



$\lambda = 0$

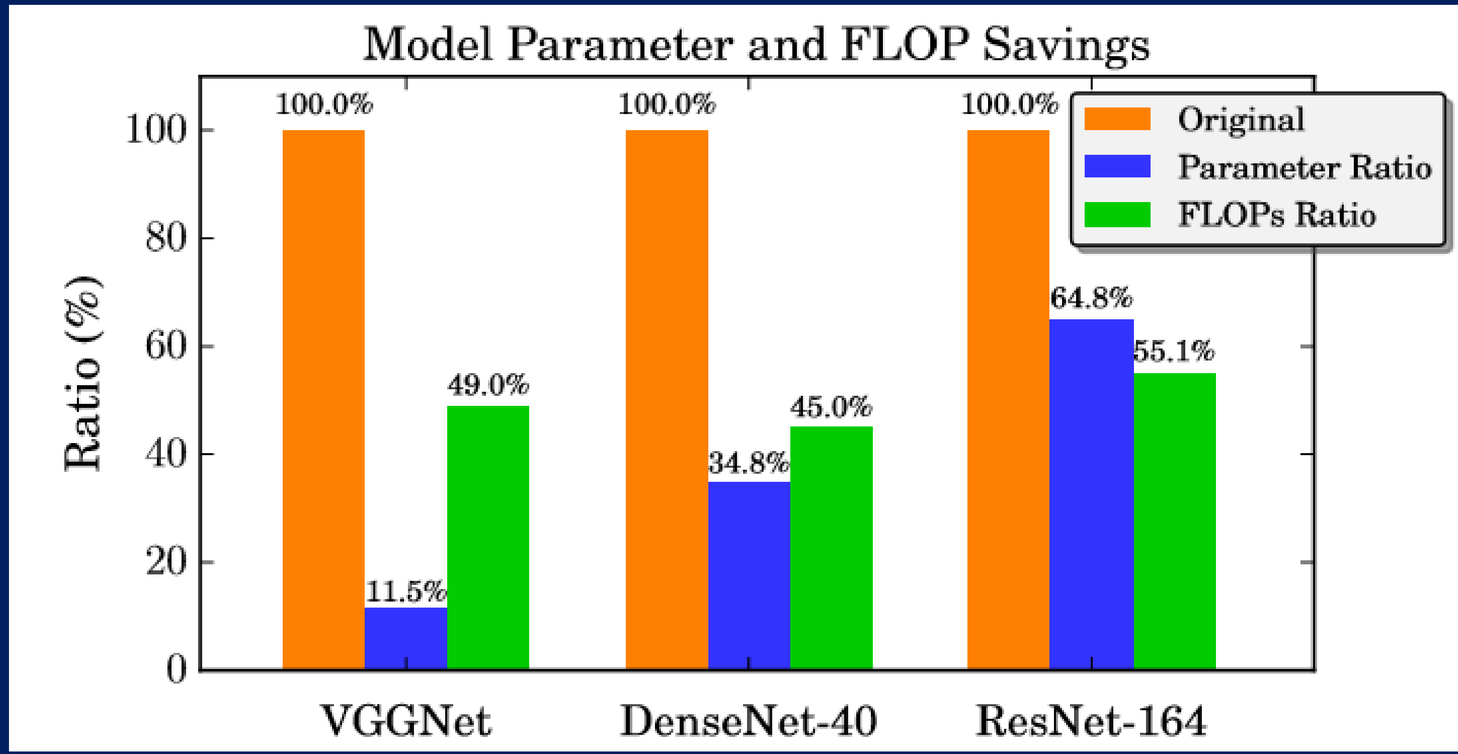


$\lambda = 0.0001$



$\lambda = 0.001$

网络压缩结果



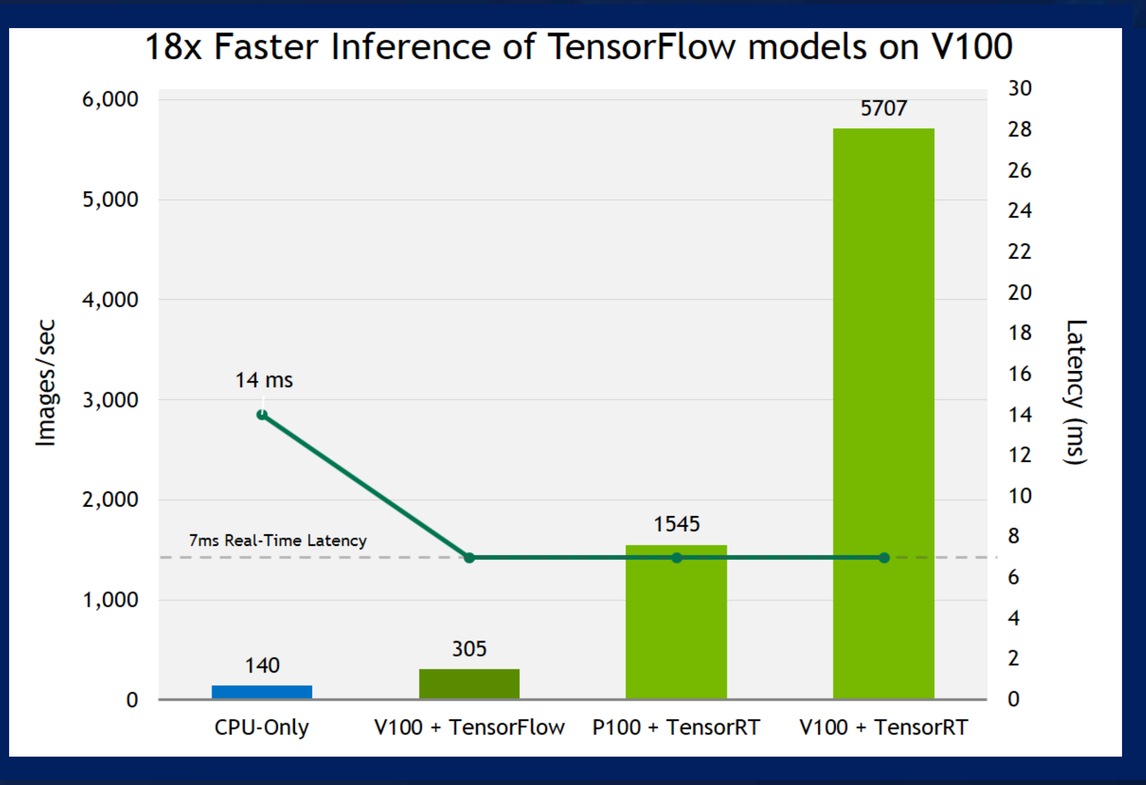
04

嵌入式GPU+CPU的加速

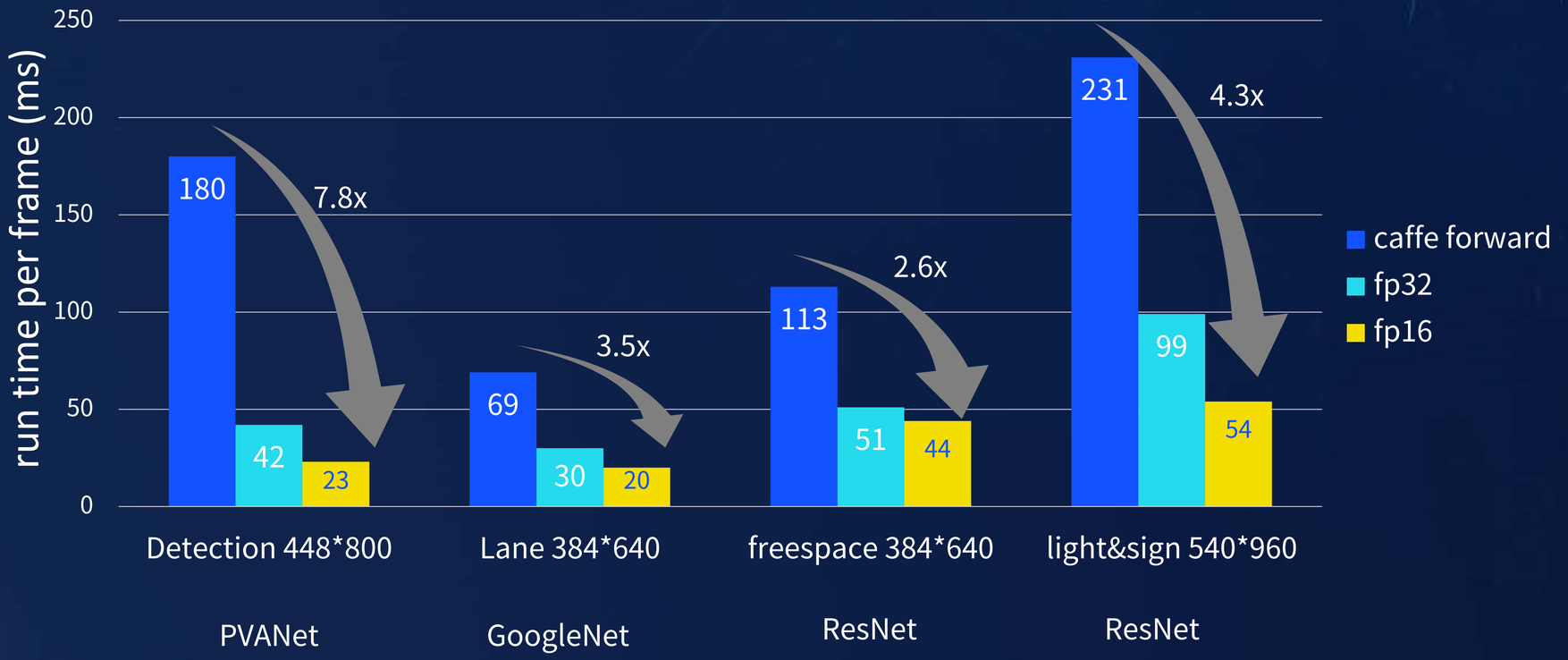
Pipeline

TensorRT

- FP16和INT8自动量化
- 多层合并
- 自动选择并行算法
- 显存动态优化
- 多任务并发



TX2上TensorRT 加速效果



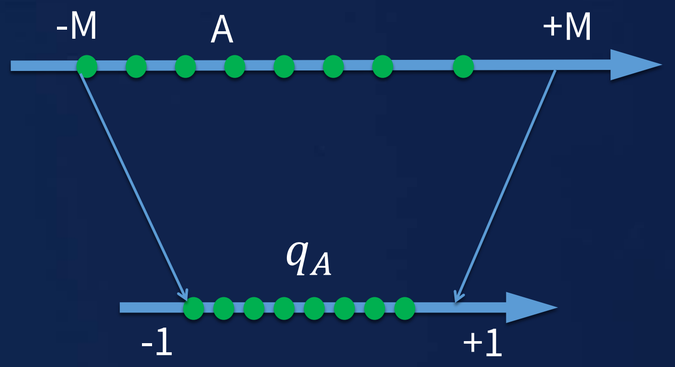
05

低成本FPGA的加速

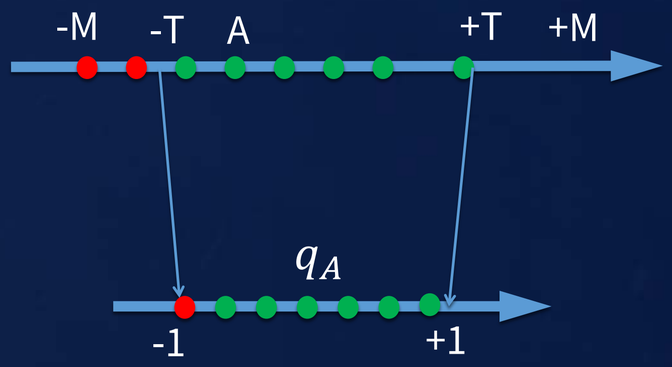
FPGA定点化

- 表示范围FP32：-3.4×10^{38}~3.4×10^{38}，INT8：-128~127
- 定点小数$A=(A_0)A_1\cdots A_k.\cdots A_n$ (A_0为符号位，A_i为0/1)代表的小数为 $(-1)^{A_0}[A_1*2^{k-1}+A_2*2^{k-2}+\cdots+A_k*2^0+\cdots+A_n*2^{k-n}]$
- 定点小数表示范围在$\pm2^k(1-0.5^n)$之间，精度（最小单位）为2^{k-n}
- 用INT8定点表示FP32： $A=2^k*(-1)^{A_0}*0.A_1A_2\cdots A_n$FP32 Value A= FP32 scale factor s_A * INT8 Value q_A
- $\sum_j A_jB_j=s_As_B\sum_j q_{Aj}q_{Bj}$

表示范围与精度的取舍



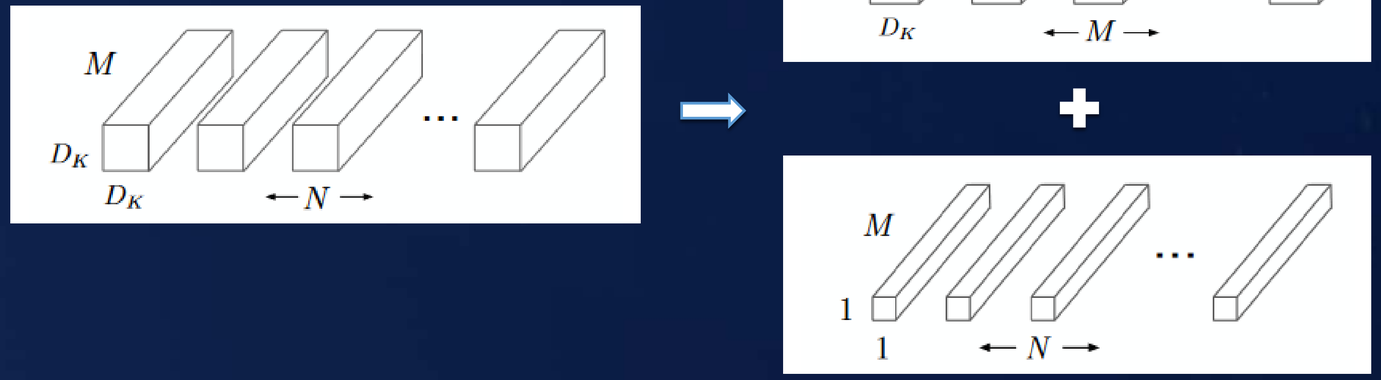
$M = \max|A| \leq 2^k$
表示范围大，精度差



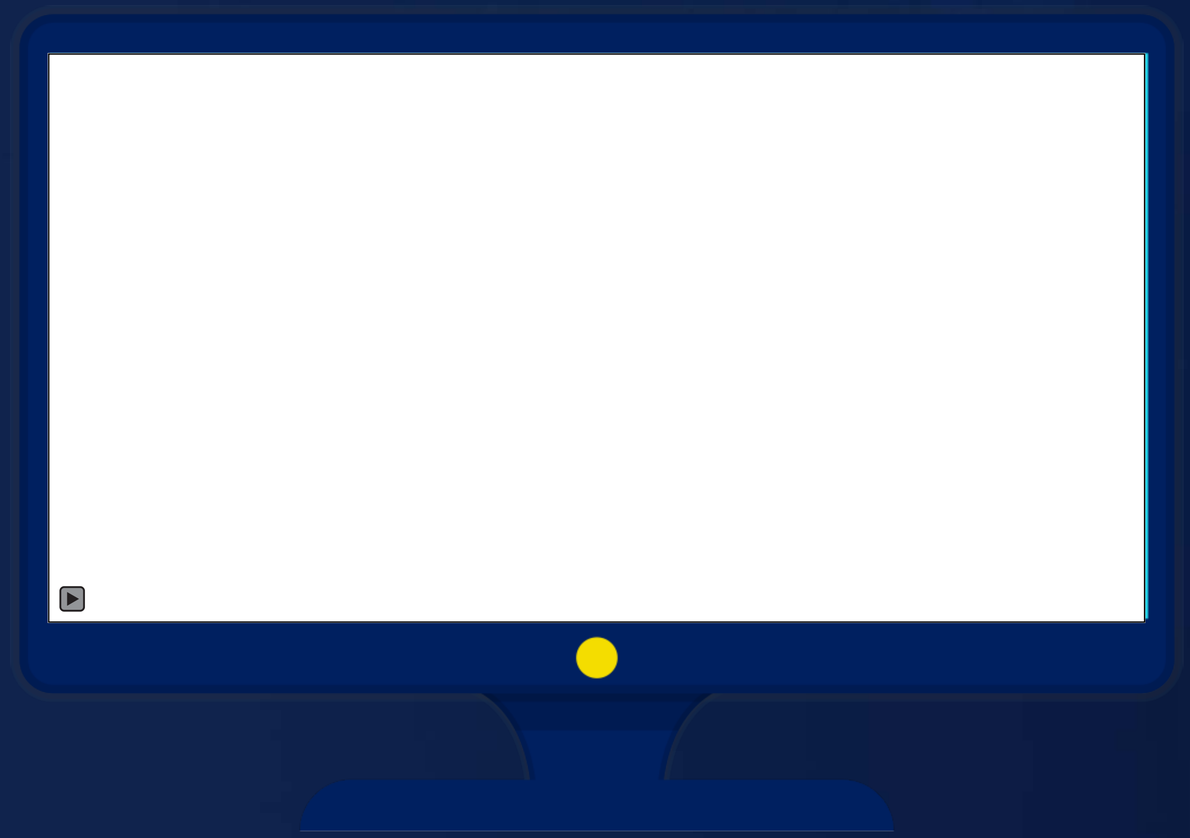
$M > T = 2^k$
表示范围小，精度好

FPGA的网络选择

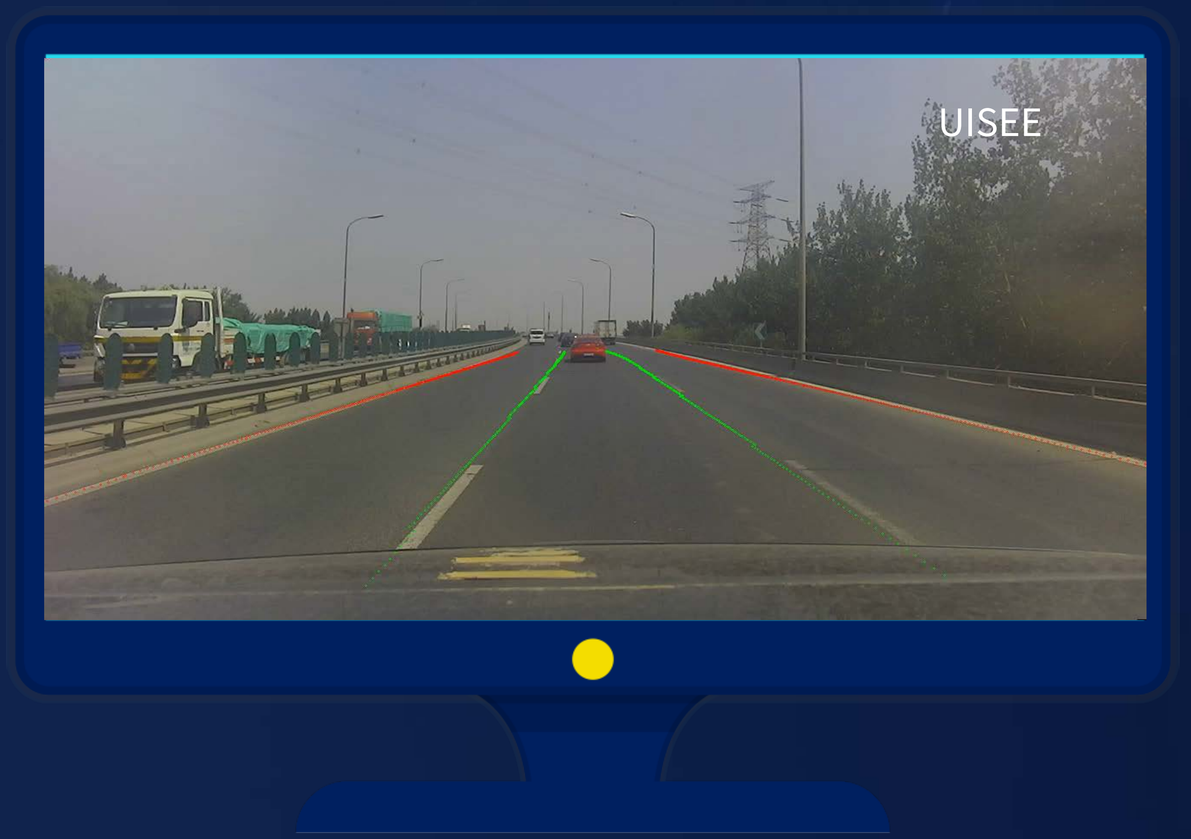
- MobileNet使用depth wise convolution+1x1 convolution
- 理论计算量低，同时精度很高
- GPU加速比比较差，但适合CPU和定制计算设备



MobileNet on FPGA



UISEE Visual Perception demo video



END 谢谢