Motivation:
Existing deep optical flow networks have achieved satisfactory results by mostly employing a pyramidal coarse-to-fine paradigm, where a key process is to adopt warped target feature based on previous flow prediction to correlate with source feature for building 3D matching cost volume. However, the warping operation can lead to troublesome ghosting problem that results in ambiguity. Moreover, occluded areas are treated equally with non-occluded regions in most existing works, which may cause performance degradation.

Innovations:
We propose a lightweight yet efficient optical flow network, named OAS-Net (occlusion aware sampling network) for accurate optical flow with following contributions:
1. A new sampling based correlation layer is employed without noisy warping operation.
2. A novel occlusion aware module is presented to make raw cost volume conscious of occluded regions.
3. A shared flow and occlusion awareness decoder is adopted for structure compactness.

Sampling Based Correlation:
Previous warping based cost volume suffers from duplicate artifacts, which is also known as ghosting. To solve the problem, we build cost volume with a novel sampling based approach that avoids warping and ghosting issues. Original flow based warping operation is replaced by directly sampling flow guided searching grids in the target pyramid feature. These two types of correlation can be formulated as:
\[ c^k(x, d) = f_1^k(x) \cdot f_{warp}^k(x + d) \]
\[ c^k(x, d) = f_1^k(x) \cdot f_2^k(x + f + d) \]
Note that the yellow cross position in the right figure becomes distinct when using the proposed sampling based correlation operation.

Occlusion Aware Module:
Although sampling based cost volume can bypass annoying ghosting feature, occluded regions are unrecoverable no matter to take either correlation methods. As shown in the left figure, the red cross pointing bush in the source image is covered by the moving arm in the target image. To endow flow estimation with occlusion awareness, we present a novel occlusion aware module to better handle two types of matching regions in raw cost volume separately, which can be formulated as:
\[ c_{oa}^k(x, d) = \text{relu}(\text{conv}_1(O(x) \otimes c^k(x, d))) \]
\[ \oplus \text{conv}_3((1 - O(x)) \otimes c^k(x, d))) \]
Proposed occlusion awareness map can also be interpreted as occlusion probability map, which can be viewed as one type of self-attention mechanism.

Ablation Study:
OAS-Net performs better than all the other approaches on Sintel Clean test dataset and surpasses PWC-Net on Sintel Final test set slightly. It achieves the same best result as HD3-Flow on KITTI 2012 test benchmark and excels LiteFlowNet and IRR-PWC.

Visual Samples:
It can be seen that our occlusion awareness maps have correctly emphasized the probable occluded regions, and help to improve optical flow accuracy.