QUALITY ESTIMATION BASED MULTI-FOCUS IMAGE FUSION

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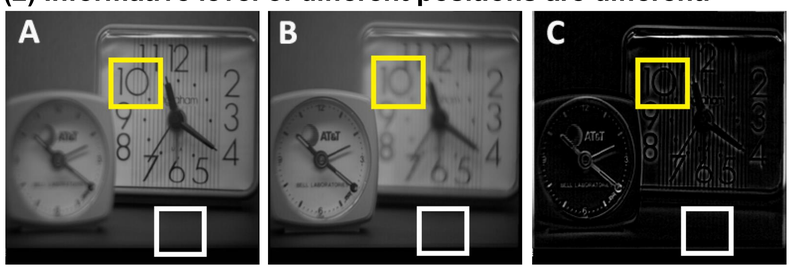
Motivation

(1) Use image quality assessment to do focus measurement.

(2) Informative level of different positions are different.



Contribution

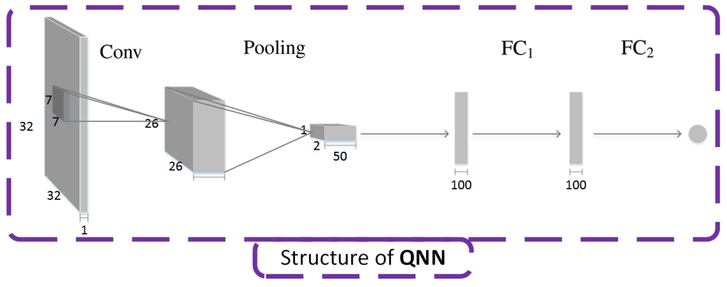
(1) The visual quality is adopted to help estimate image focus levels. The rich images with subjective evaluation results in IQA datasets can be utilized.

(2) The confidence map is explored during the focus measurement. A higher confidence corresponds to a more reliable region.

Proposed QEBIF method

- **Focus level weighted summation model**

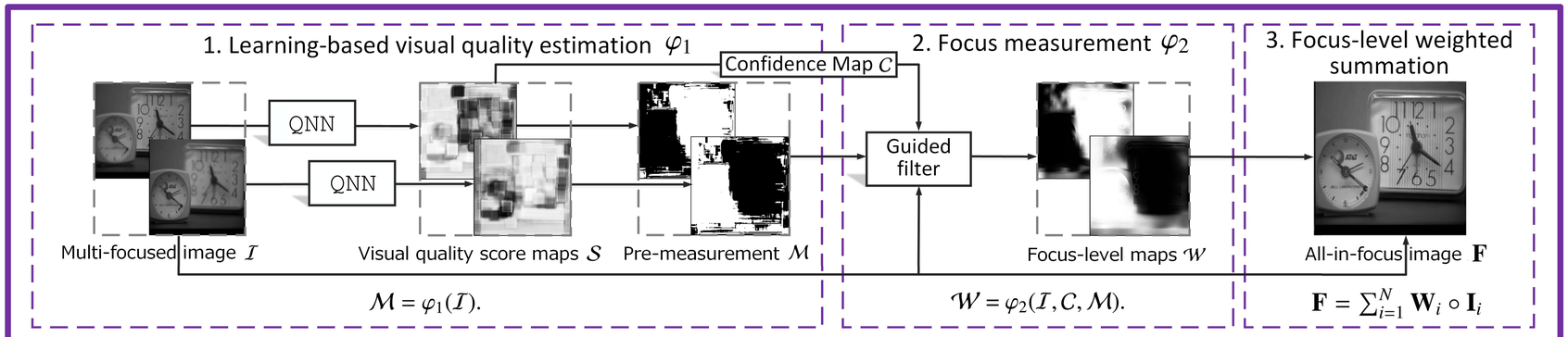
$$\mathbf{F} = \sum_{i=0}^{N} W_i \circ I_i, i \in \{1,2,\dots,N\}$$



Structure of **QNN**

Reference:

[24] Kaiming He, Jian Sun, and Xiaoou Tang, "Guided image filtering," in Proc. ECCV. Springer, 2010, pp. 1–14



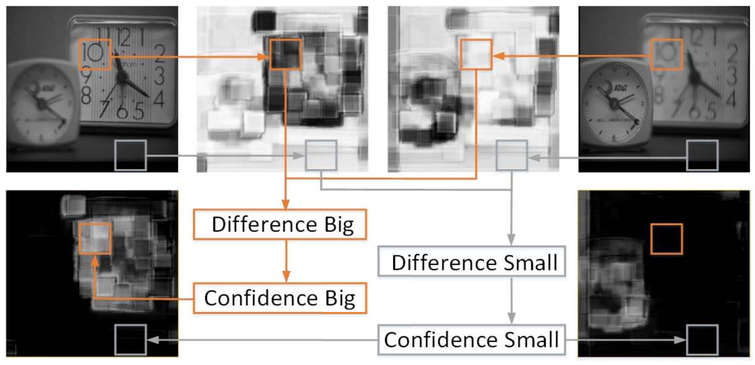
(1) Learning-based visual quality estimation φ_1: $M_i = \varphi_1(I_i)$

- $S_i = \mathbf{QNN}(I_i)$
- $M_i = \begin{cases} 1, if\ \min\big(S_1(x,y), \dots, S_N(x,y)\big) = S_i(x,y) \\ 0, otherwise. \end{cases}$

However, the pre-measurement M_i is not ideal to do the fusion.

(2) Focus measurement φ_2: $W_i = \varphi_2(I_i, C_i, M_i)$.

- Confidence Map C_i



$$S_{max}(x,y) = \max\big(S_1(x,y), \dots, S_N(x,y)\big);$$
$$C_i(x,y) = \max\big((S_{max}(x,y) - S_i(x,y)\big), T)$$

- The guide filter [24]

Input: M_i | The guidance image I_i | Output: W_i

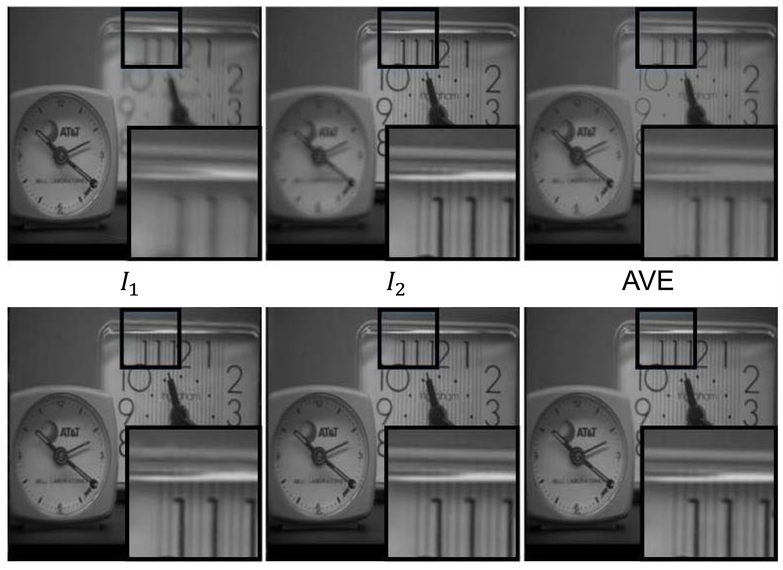
Step 1: $W_i(k) = a(r)I_i(k) + b(r), \quad \forall k \in w(r)$
Step 2: $W_i(k) = a(k)I_i(k) + b(k),$

$$a(k) = \frac{\sum_{r \in w(k)} a(r) \circ C_i(r)}{\sum_{r \in w(k)} C_i(r)}, \quad b(k) = \frac{\sum_{r \in w(k)} b(r) \circ C_i(r)}{\sum_{r \in w(k)} C_i(r)}$$

Experiments

(1) Fusion results

- Visualization



I_1 | I_2 | AVE

Liu et al. [4] | *Li et al.* [2] | QEBIF

- Use objective evaluation metrics.

MI	clock	pepsi	Disk
AVG	6.79	5.53	5.39
Liu et al.	7.76	7.91	7.62
Li et al.	7.79	8.29	7.62
QEBIF	**8.15**	**8.42**	**7.77**

(2) Component analysis

MI	clock	pepsi	Disk
QEBIF (Without C)	8.06	8.37	7.69
QEBIF (With C)	**8.15**	**8.42**	**7.77**