Yang Chen, Zheng Qin, 2015. Gradient-based compressive image fusion. *Frontiers of Information Technology & Electronic Engineering*, **16**(3):227-237. [doi:10.1631/FITEE.1400217]

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Gradient-based compressive image fusion

Key words: Compressive sensing (CS), Image fusion, Gradient-based image fusion, CS-based image fusion

Contact: Yang Chen
E-mail: yang-chen07@mails.tsinghua.edu.cn
ORCID: http://orcid.org/0000-0003-0927-000X

Introduction

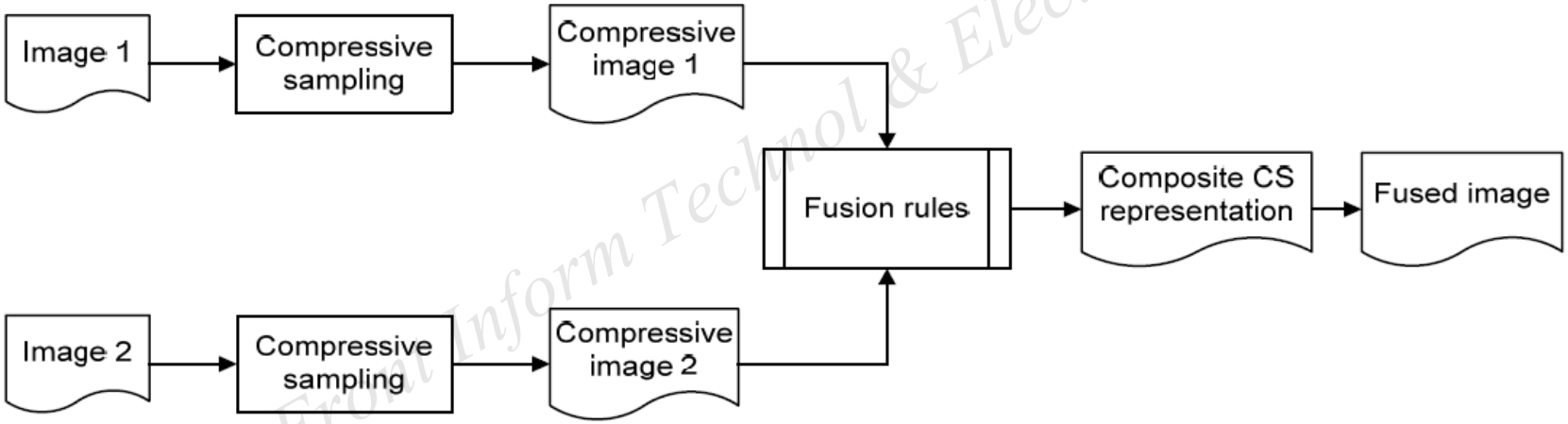
- Since multiple image sensors are widely employed in many fields, it is necessary to explore the scenario adaptabilities of different fusion schemes for different scenarios.

- A compressive image framework and a gradient-based compressive image fusion scheme are proposed.

- From the experimental results, we prove that the proposed image fusion scheme is efficient in terms of both subjective judgment and objective metrics for compressive image fusion.

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Gradient-based compressive image fusion framework



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Fig. 1 Compressive image fusion framework

Experimental results: multi-focus images fusion (clock)

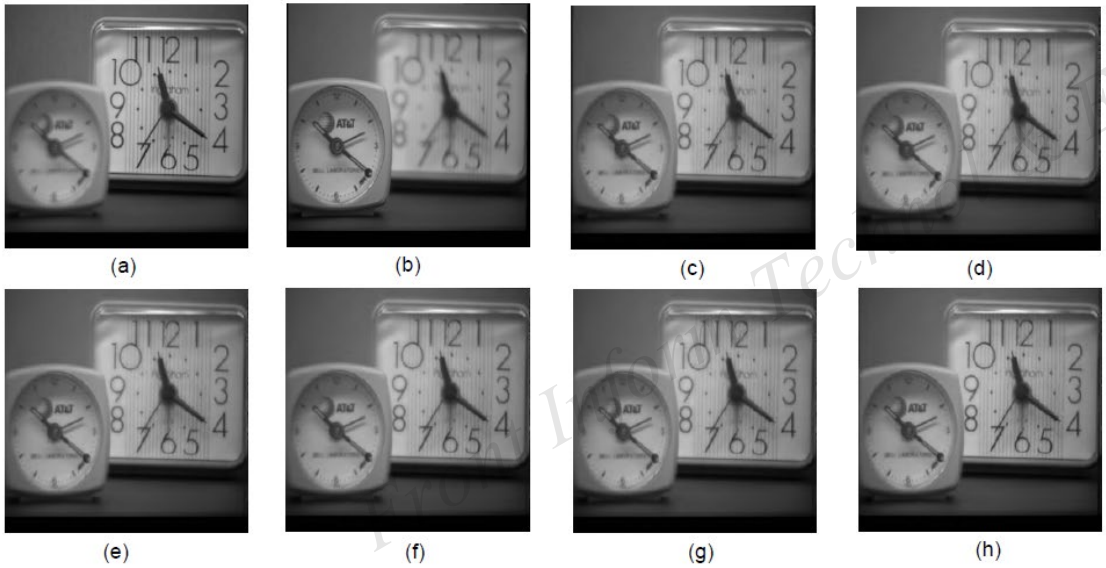


Fig. 2 Multi-focus image fusion (clock)

(a) is the left-focus clock, (b) is the right-focus clock, and (c)–(h) are fusion results under the average scheme, mean scheme, variance scheme, PCA scheme, MI scheme, and the proposed scheme, respectively

Table 1 Comparison of fusion schemes for multi-focus images (clock) among different metrics

Scheme	IE	Xydeas	Q^*	Qw^*	Qe^*
CS_Avg	7.3939	0.4174	0.6133	0.7747	0.4878
CS_Mean	7.3814	0.4200	0.6071	0.7550	0.4648
CS_Var	7.3818	0.4182	0.6071	0.7552	0.4642
CS_PCA	7.3812	0.4183	0.6068	0.7546	0.4642
CS_MI	7.3843	0.4227	0.6085	0.7580	0.4690
Proposed	7.4014	0.5155	0.6230	0.7941	0.5668

* Piella's indexes

Experimental results: multi-focus images fusion (pepsi)

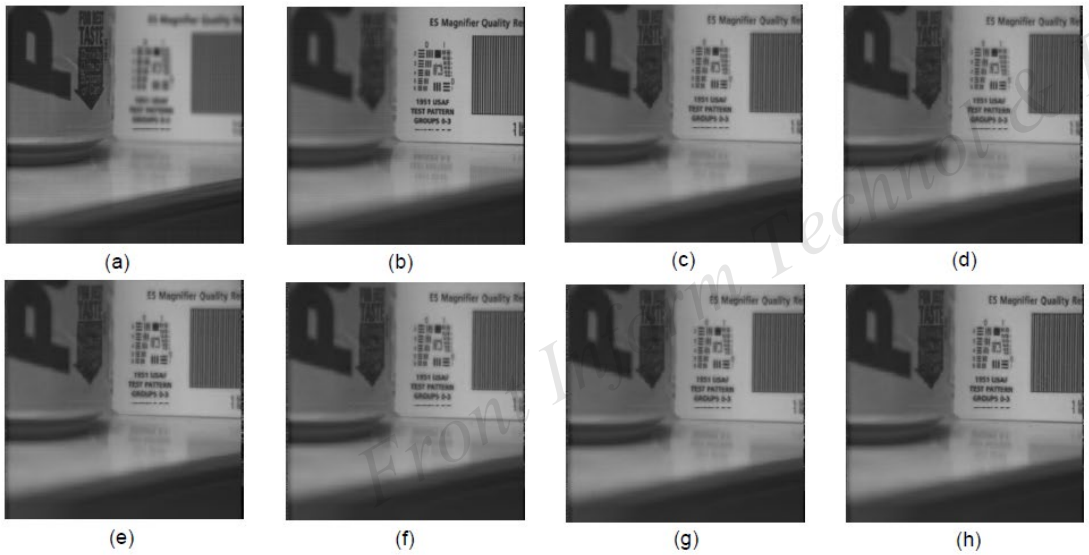


Fig. 3 Multi-focus image fusion (pepsi)

(a) is the left-focus pepsi, (b) is the right-focus pepsi, and (c)–(h) are fusion results under the average scheme, mean scheme, variance scheme, PCA scheme, MI scheme, and the proposed scheme, respectively

Table 2 Comparison of fusion schemes for multi-focus images (pepsi) among different metrics

Scheme	IE	Xydeas	Q*	Qw*	Qe*
CS_Avg	7.0311	0.1937	0.4406	0.6361	0.3899
CS_Mean	7.0312	0.1939	0.4405	0.6354	0.3876
CS_Var	6.2262	0.1174	0.4028	0.4682	0.2052
CS_PCA	7.0312	0.1932	0.4410	0.6373	0.3918
CS_MI	7.0314	0.1927	0.4415	0.6393	0.3979
Proposed	7.0325	0.1853	0.4562	0.6826	0.5086

* Piella's indexes

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Experimental results: image fusion of infrared and visible light (frame 1800)

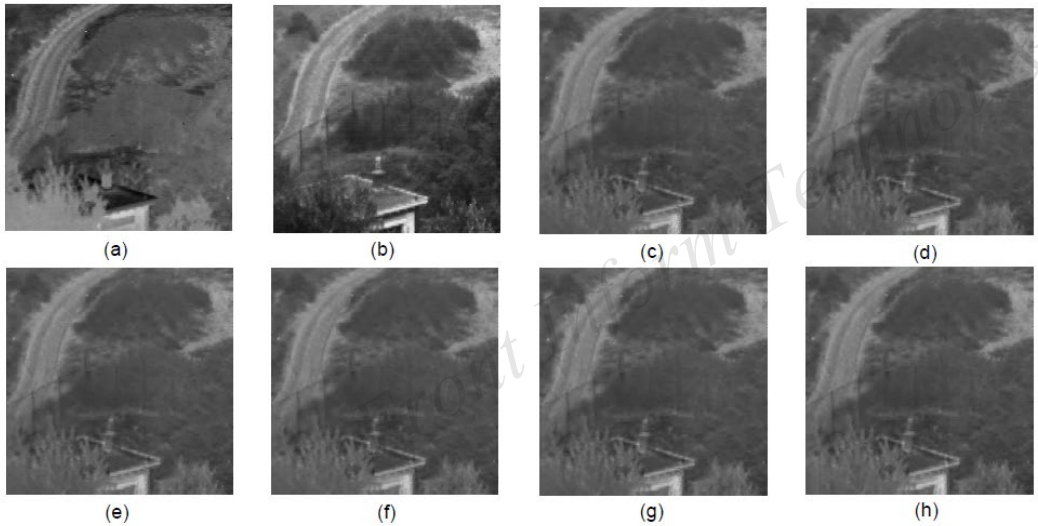


Fig. 5 Image fusion of infrared and visible light (frame 1800)
(a) is the infrared image, (b) is the visible light image, and (c)–(h) are fusion results under the average scheme, mean scheme, variance scheme, PCA scheme, MI scheme, and the proposed scheme, respectively

Table 4 Comparison of fusion schemes for infrared and visible light images (frame 1800) among different metrics

Scheme	IE	Xydeas	Q*	Qw*	Qe*
CS_Avg	6.1771	0.1133	0.4059	0.4581	0.1965
CS_Mean	6.1709	0.1143	0.4038	0.4569	0.1963
CS_Var	6.1828	0.1135	0.4046	0.4573	0.1953
CS_PCA	6.1862	0.1136	0.4049	0.4584	0.1964
CS_MI	6.1752	0.1174	0.4054	0.4578	0.1968
Proposed	6.2033	0.1180	0.4068	0.4625	0.2071

* Piella's indexes

Experimental results: image fusion of infrared and visible light (frame 1807)

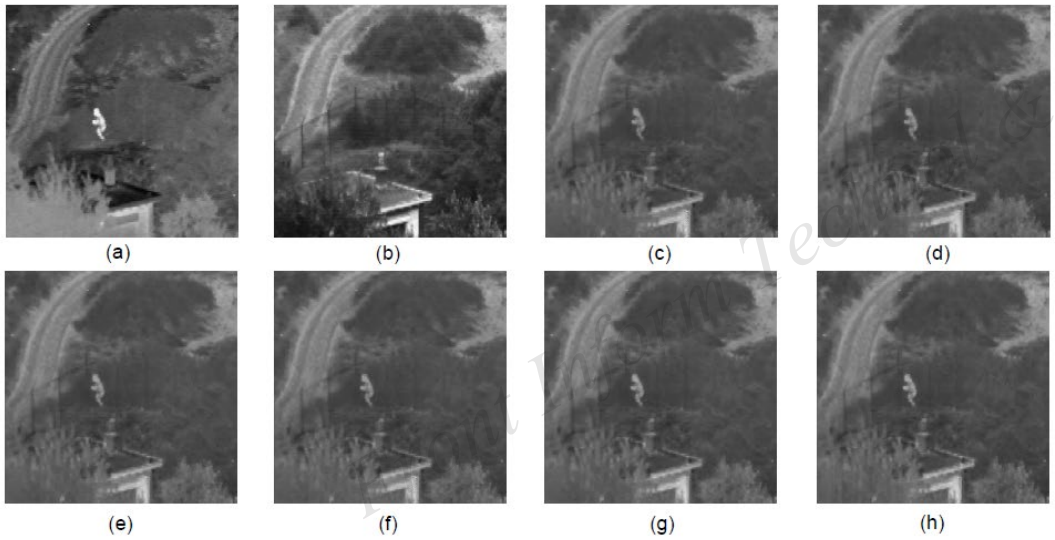


Fig. 6 Image fusion of infrared and visible light (frame 1807)
(a) is the infrared image, (b) is the visible light image, and (c)–(h) are fusion results under the average scheme, mean scheme, variance scheme, PCA scheme, MI scheme, and the proposed scheme, respectively

Table 5 Comparison of fusion schemes for infrared and visible light images (frame 1807) among different metrics

Scheme	IE	Xydeas	Q^*	Qw^*	Qe^*
CS_Avg	6.2244	0.1129	0.4059	0.4718	0.2102
CS_Mean	6.2106	0.1165	0.4030	0.4687	0.2066
CS_Var	6.2262	0.1174	0.4028	0.4682	0.2052
CS_PCA	6.2297	0.1187	0.4026	0.4685	0.2060
CS_MI	6.2168	0.1191	0.4021	0.4678	0.2058
Proposed	6.2670	0.1194	0.4067	0.4752	0.2208

* Piella's indexes

Conclusions

- Gradient-based fusion scheme, proposed in this paper, is efficient in terms of both subjective judgement and objective metrics for compressive image fusion.
- Gradient-based fusion scheme proposed in this paper is adaptive for different fusion scenarios.

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