Bulletin of Electrical Engineering and Informatics
Vol. 13, No. 2, April 2024, pp. 1007~1014
ISSN: 2302-9285, DOI: 10.11591/eei.v13i2.5951

A comprehensive achievement investigation of iterative mean filter for outlier extinguish aspiration on ubiquitous FVIN

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Article Info

Article history:

Received Feb 7, 2023
Revised Sep 17, 2023
Accepted Sep 29, 2023

Keywords:

Adaptive median filter
Digital image denoising
Digital image processing
Iterative mean filter
Mean filter
Standard median filter

ABSTRACT

Under commonwealth of the outlier extinguish inspection, exclusively on the impulsive outlier, the outlier extinguish algorithm is a substantial step, which is early performed prior to further computer vision steps thereupon the iterative mean filter (IMF) is inaugurated for fix value impulsive noise (FVIN) and grown into one of the superior achievement outliers extinguish algorithms. This academic article focuses to investigate the correlative achievement of the outlier extinguish algorithm established on IMF, is inaugurated from mean filter (MF) for carrying out the poor achievement of the aforesaid outlier extinguish algorithms (standard median filter (SMF), MF, and adaptive median filter (AMF)), for FVIN at omnipresent scattering of outlier consistency (5-90%). The analytical experiment comprehensively exploits on bountiful figures (F16, Girl, Lena, and Pepper) that are inspected in order to analyze the correlative achievement of an outlier extinguish algorithm established on IMF. In contrast with the aforesaid outlier extinguish algorithms (SMF, MF, and AMF), the outlier extinguish algorithm established on IMF has superior achievement from the experimental results.

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1. INTRODUCTION

Under commonwealth of digital image processing and computer vision [1], there are bountiful ongoing utilizations on digital figures [2], [3] in this last twenty years thereupon one of the substantial steps for ongoing computer vision utilizations [4] for instant several-frame super-resolution (SR) [5], one-frame SR [6], and face categorization [7], is the outlier extinguish algorithm because progressed digital image processing algorithms [4]–[7] are naturally delicacy to outlier. Under the circumstances, the outlier extinguish algorithm is one of substantial steps for ongoing computer vision utilizations thereupon there are bountiful inventions for desiring proficient outlier extinguish algorithms, which early is made of an outlier detection algorithm and an outlier extinguish algorithm. The standard median filter (SMF) [8] was early inaugurated for extinguishing fix value impulsive noise (FVIN) and next, has been grown into one of the superior achievement outliers extinguish algorithms. In order to extinguish FVIN on color figures, the vector median filter (VMF) [9], which is inaugurated from the ordinary SMF, was prospected to be one of the classic outlier extinguish algorithms for color figures. After, an adaptive median filter (AMF) [10], which was extended from SMF with an expanding progressed window, was inaugurated to be an outlier extinguish

algorithm for FVIN in 1994 and next, has been prospected to be one of the classic outlier extinguish algorithms with the superior achievement. The outlier extinguish algorithm [11] established on both a value limitation cast extinguish and a swarm augmentation was inaugurated for engaging color figures. Forthwith, self-moving electronic-abetment examination algorithm [12] established on a support vector machine (SVM) description for magnetic resonance imaging (MRI) brain figures was inaugurated in 2017. Later, the outlier extinguish algorithm [13] established on an outlier regularity estimation by restricted-area statistics was inaugurated for digital figures in 2018. The outlier extinguish algorithm [14] established on a forceful filtering technique was subsequently inaugurated for color figures. Succeeding, the alternative outlier extinguish algorithm [15] established on the combination of the Wiener filtering and the Gaussian filtering was analyzed its achievement by fluctuating kernel specification in 2019. After, the outlier extinguish algorithm established on a filtering technique [16] was analyzed its achievement on medical figures in 2019. The bountiful outlier extinguish algorithms established on particular techniques are inspected and correlative analyzed on many outlier extinguish perspectives by Charmouti *et al*. [17]. The alternative outlier extinguish algorithm established on a compartmental wavelet technique [18], which is expanded from Haar wavelet as compartment order by a low-pass filtering generalization with the compartment delay operation, was inaugurated. For employing on underwater acoustic outlier, the outlier extinguish algorithm established on discrete wavelet transform (DWT) [19] with outlier consistency assessment was inaugurated in 2020.

2. THE CONCEPT OF MODERN OUTLIER EXTINQUISH ALGORITHMS

The bountiful ongoing outlier extinguish algorithms [20]–[23], which were generally invented of outlier detection algorithms and outlier extinguish algorithms, have been inaugurated as successive. The outlier extinguish algorithm established on an in-cross stochastic technique [20] was inaugurated for extinguishing an impulse outlier. For dense scattering consistency of FVIN, alternative outlier extinguish algorithm, so called the adaptive decision based inverse distance weighted interpolation (DBIDWI) algorithm [21], [22], which was inaugurated by Kishorebabu *et al*. [21], was analyzed its achievement [22] upon around omnipresent scattering on FVIN in 2019. Bountiful ongoing outlier extinguish algorithms [23] established on ROAD, ROLD and RORD are correlatively analyzed for perceiving the impulse outlier. As following, the outlier extinguish algorithm established on triple threshold statistical detection (TTSD) technique [24] was inaugurated for FVIN in 2018. Afterwards, the outlier extinguish algorithm established on iterative mean filter (IMF) technique [25], which is expanded from the traditional SMF technique, early is expanded for FVIN at high density in 2019 and this algorithm can produce superior achievement. As a results, this academic article addresses to inspect the outlier extinguish approach established on IMF [26], which is exploited on bountiful figures that are unified of F16, Girl, Lena, and Pepper.

3. THE CONCEPT OF NOVEL ITERATIVE MEAN FILTER

The vital expectation of IMF is inaugurated from mean filter (MF) because the MF has a superior achievement for low scattering of an outlier consistency and, furthermore, is a simple complication. Whereas, the MF occupies a non-expanding progressed window in contrast with expanding progressed window filter such as AMF, adaptive weighted MF, modified decision-based untrimmed median filter, and noise adaptive fuzzy switching median filter. To necessarily prospect IMF, early the IMF occupies the dominance of MF with a non-expanding progressed window with 3×3. In due course, IMF reinforces this dominance with the non-expanding progressed window in contrast with expanding the progressed window filter.

In the early step, the enumerated figure information is catalogued as an identified outlier information on this hypothesis that the figure information only is 0 or 255 otherwise the enumerated figure information is catalogued as non-outlier information. In the later step, entirely enumerated figure information, which is catalogued as an identified outlier information, are exploited by arranging a nonexpanding progressed window to be 3×3. In this 3×3 window, there are any enumerated figure information that is catalogued as an identified non-outlier information thereby the outlier extinguished output is the statistical mean of every non-outlier information in a nonexpanding progressed window. If every figure information in a nonexpanding progressed window is outlier information, then the enumerated figure information is not revised. In the finishing step, the enumerated step will progress to the early step until the enumerated figure information (after enumeration) is merely indistinguishable to the enumerated figure information (before enumeration). The complementary computational blueprint of iterative MF is likewise operated in Figure 1.

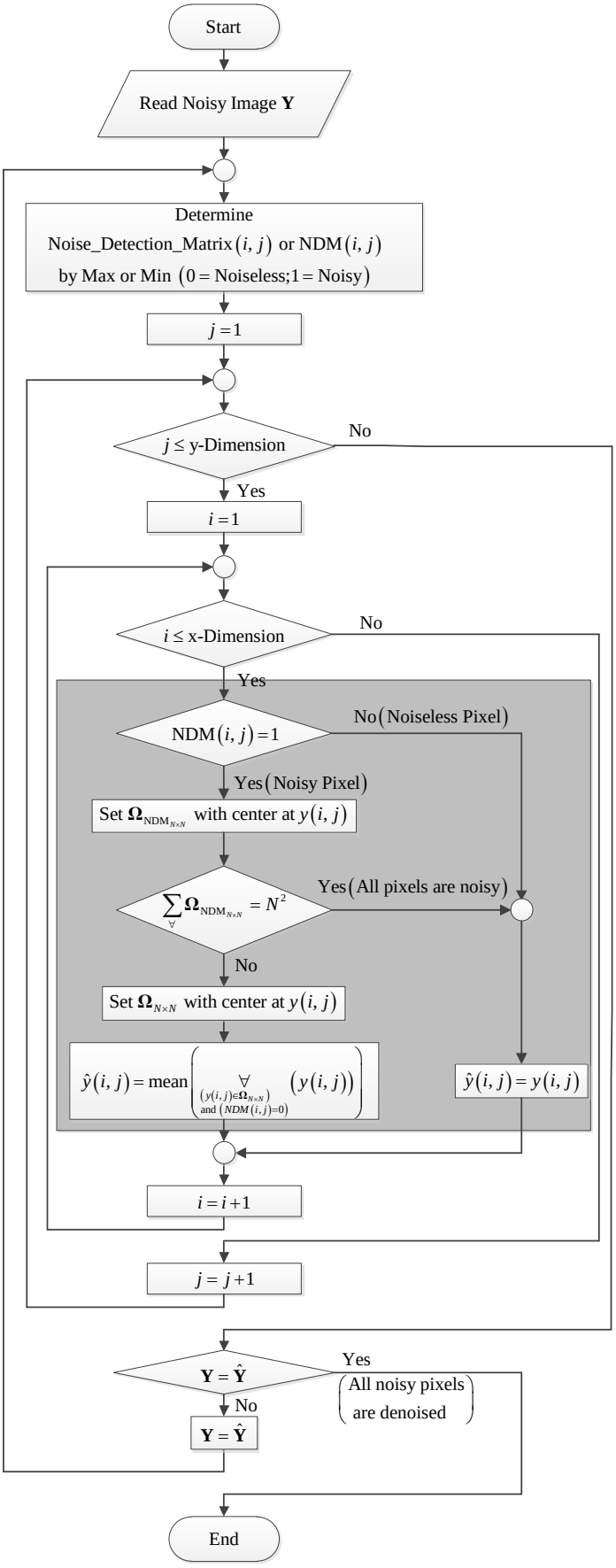


Figure 1. The corresponding flow diagram of the IMF

4. THE EXPERIMENT RESULTS

In the branch of experiments, the productivity software is the MATLAB, which is built and experimented on bountiful desktops with appliance technicalities: central processing unit i7-6700HQ and 16 GB RAM. Particular desktops are examined on bountiful figures (which are composed of F16, Girl, Lena, and Pepper) and all experimental figures are manufactured with FVIN at omnipresent scattering of outlier consistency (5-90%). For outlier extinguish aspiration omnipresent scattering of outlier consistency, experimental fallout of achievement of IMF on bountiful figures: F16, Girl, Lena, and Pepper are exemplified in Tables 1-4, correspondingly. In order to decorate the outlier, extinguish achievement, the IMF is exemplified in contrast with bountiful outlier extinguish algorithms: SMF, MF, and adaptive mean filter (AMF). As results on F16 figure in Table 1, the widespread outlier extinguish achievement of IMF has a preferable signal-to-noise-ratio (in decibel) in greater contrast with MF, SMF, and AMF capable of nearly 18.7820±1.4897 dB, 14.4276±3.8904 dB, and 8.5950±2.7771 dB, correspondingly. As results on Girl figure in Table 2, the widespread outlier extinguish achievement of IMF has a preferable signal-to-noise-ratio (in decibel) in greater contrast with MF, SMF, and AMF capable of nearly 22.2332±1.1497 dB, 16.8771±5.4664 dB, and 9.1185±4.2149 dB, correspondingly.

Table 1. The simulation of fallout of an outlier extinguish approach established on IMF in peak signal to noise ratio (PSNR) (F16)

Progressed figure	Outlier consistency (%)	PSNR (dB)				
		Outliered figure	Outlier extinguish approach			
			3×3 MF	3×3 SMF	AMF	IMF
F16 (256×256)	D=5	18.7139	22.4181	31.6421	36.0907	43.3066
	D=10	15.6564	19.3812	30.7076	35.3032	39.3435
	D=15	13.8274	17.5385	29.2982	33.7454	37.7321
	D=20	12.6389	16.3208	27.6257	32.1558	36.3640
	D=25	11.6783	15.3526	25.4101	29.8105	35.3774
	D=30	10.8971	14.5829	23.6811	27.9141	34.2020
	D=35	10.2240	13.8785	20.8127	25.6654	33.5486
	D=40	9.6481	13.2479	19.0080	23.7903	32.6309
	D=45	9.0745	12.6598	16.8389	21.5949	32.1962
	D=50	8.6553	12.2146	15.4758	20.5725	31.4579
	D=55	8.2118	11.7609	13.8573	19.4896	30.5317
	D=60	7.7813	11.2939	12.3280	18.1747	29.6443
	D=65	7.4884	11.0012	11.3251	17.7283	29.2552
	D=70	7.1697	10.6509	10.2861	17.1153	28.6496
	D=75	6.8497	10.2599	9.1271	16.5388	27.8557
	D=80	6.5846	10.0057	8.3331	16.4554	26.9546
	D=85	6.3241	9.7338	7.5344	16.4230	26.0117
	D=90	6.0604	9.4356	6.8241	16.5352	24.7510

Table 2. The simulation of fallout of an outlier extinguish approach established on IMF in PSNR (Girl)

Progressed figure	Outlier consistency (%)	PSNR (dB)				
		Outliered figure	Outlier extinguish approach			
			3×3 MF	3×3 SMF	AMF	IMF
Girl (256×256)	D=5	16.4490	20.0454	32.4867	37.5518	39.2602
	D=10	13.6890	17.2530	31.5583	36.8900	38.2589
	D=15	11.9287	15.3515	27.6179	34.8060	37.0817
	D=20	10.6567	13.9593	25.5153	32.0377	36.4526
	D=25	9.5498	12.7248	22.9614	29.6044	35.5644
	D=30	8.8677	11.9599	20.7738	27.6911	35.1688
	D=35	8.0984	11.0501	18.4410	24.9701	34.0890
	D=40	7.5798	10.4543	16.5146	23.3733	33.7534
	D=45	7.0728	9.8471	14.8145	21.8116	33.2616
	D=50	6.5712	9.2367	13.0319	20.1711	32.3061
	D=55	6.2085	8.7895	11.8226	19.2184	31.8671
	D=60	5.8609	8.3590	10.4981	18.4518	31.3572
	D=65	5.4832	7.8712	9.1396	17.2740	30.5575
	D=70	5.1311	7.4271	8.0463	16.7334	29.9643
	D=75	4.8712	7.0814	7.1994	16.2921	29.2431
	D=80	4.5674	6.6881	6.2520	16.2795	28.6091
	D=85	4.3054	6.3340	5.4218	16.5924	27.4307
	D=90	4.0573	5.9986	4.7465	16.7463	26.4031

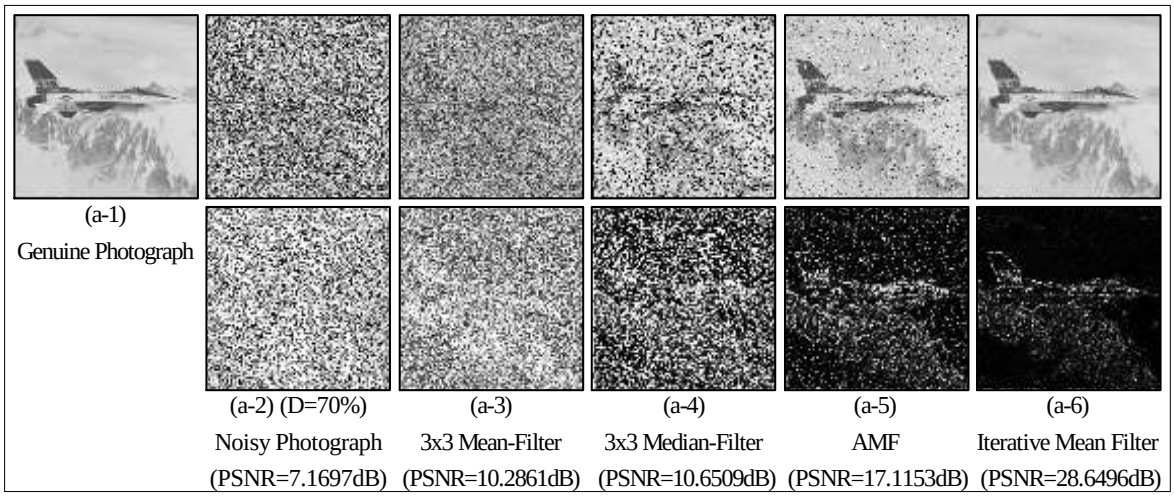
Table 3. The simulation of fallout of an outlier extinguish approach established on IMF in PSNR (Lena)

Progressed figure	Outlier consistency (%)	PSNR (dB) Outliered figure	Outlier extinguish approach 3×3 MF	3×3 SMF	AMF	IMF
Lena (256×256)	D=5	18.7139	22.4181	31.6421	36.0907	43.3732
	D=10	15.6564	19.3812	30.7076	35.3032	40.2721
	D=15	13.8274	17.5385	29.2982	33.7454	38.3247
	D=20	12.6389	16.3208	27.6257	32.1558	36.9552
	D=25	11.6783	15.3526	25.4101	29.8105	35.6980
	D=30	10.8971	14.5829	23.6811	27.9141	34.9129
	D=35	10.2240	13.8785	20.8127	25.6654	33.9037
	D=40	9.6481	13.2479	19.0080	23.7903	33.0879
	D=45	9.0745	12.6598	16.8389	21.5949	32.4656
	D=50	8.6553	12.2146	15.4758	20.5725	31.8685
	D=55	8.2118	11.7609	13.8573	19.4896	31.1126
	D=60	7.7813	11.2939	12.3280	18.1747	30.3621
	D=65	7.4884	11.0012	11.3251	17.7283	29.6967
	D=70	7.1697	10.6509	10.2861	17.1153	28.9530
	D=75	6.8497	10.2599	9.1271	16.5388	27.9784
	D=80	6.5846	10.0057	8.3331	16.4554	27.2403
	D=85	6.3241	9.7338	7.5344	16.4230	26.6650
	D=90	6.0604	9.4356	6.8241	16.5352	25.2845

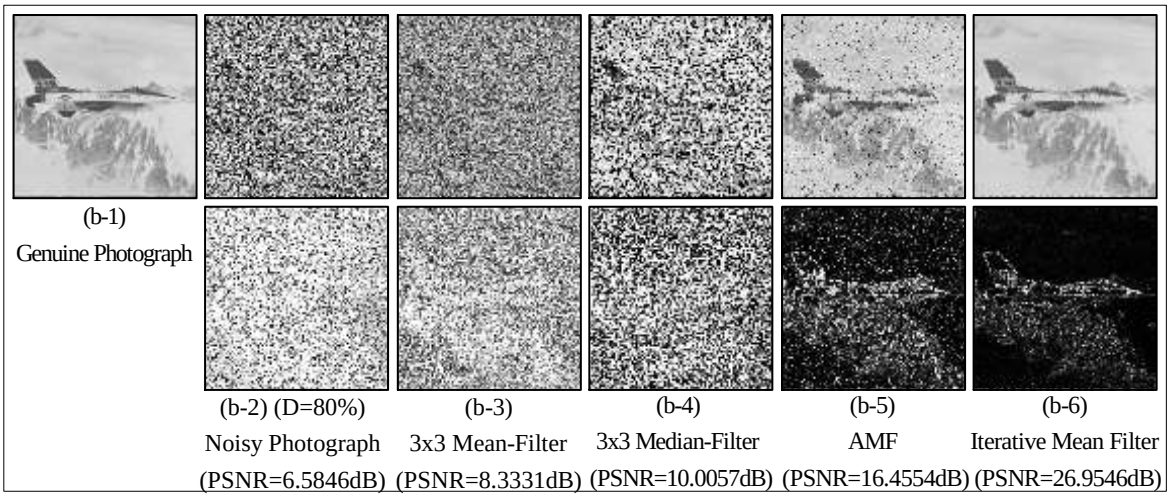
Table 4. The simulation of fallout of an outlier extinguish approach established on IMF in PSNR (Pepper)

Progressed figure	Outlier consistency (%)	PSNR (dB) Outliered figure	Outlier extinguish approach 3×3 MF	3×3 SMF	AMF	IMF
Pepper (256×256)	D=5	18.4752	22.1408	32.2578	37.1145	43.1366
	D=10	15.3798	19.0677	30.6116	36.0391	39.7060
	D=15	13.5570	17.2234	28.8470	33.6095	38.2536
	D=20	12.3593	15.9804	26.5888	31.6485	36.7020
	D=25	11.3929	14.9986	24.2073	29.4205	35.5669
	D=30	10.6242	14.1748	22.0663	26.7650	34.5960
	D=35	9.9742	13.5209	20.3774	25.5249	33.6614
	D=40	9.3998	12.9076	18.4321	23.4995	32.9642
	D=45	8.8599	12.3275	16.6168	21.7177	31.9280
	D=50	8.3843	11.8117	14.8506	20.2203	31.5746
	D=55	7.9930	11.3720	13.4655	19.0894	30.7520
	D=60	7.6189	10.9563	12.0128	18.1116	29.9063
	D=65	7.2684	10.5758	10.8920	17.3657	29.3337
	D=70	6.9246	10.2039	9.7704	16.5923	28.4963
	D=75	6.6418	9.8955	8.8751	16.2338	27.6334
	D=80	6.3710	9.5853	8.0166	16.0896	26.7063
	D=85	6.1097	9.2949	7.2402	16.0498	25.6484
	D=90	5.8582	9.0214	6.5767	16.2932	24.5079

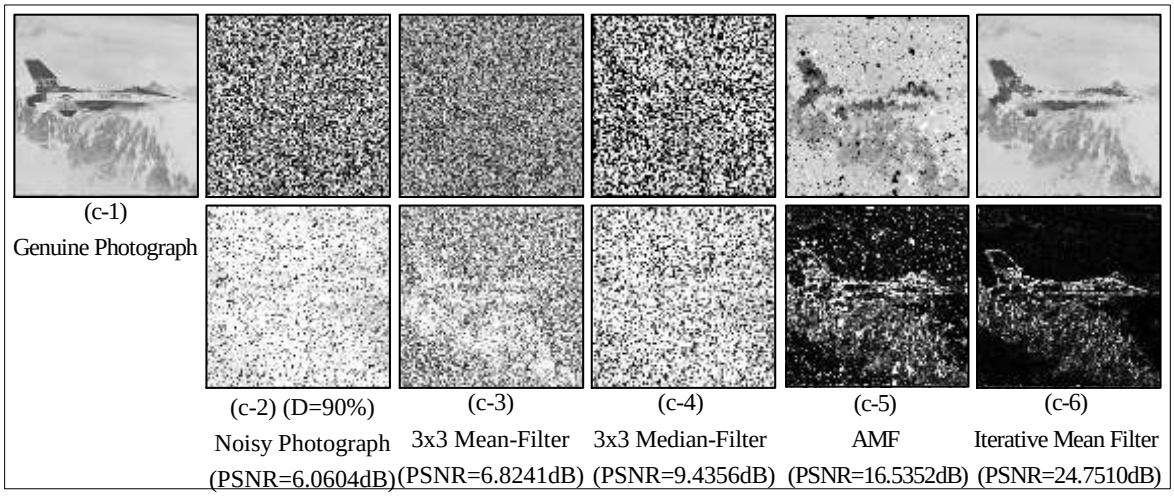
As results on Lena figure in Table 3, the widespread outlier extinguish achievement of IMF has a preferable signal-to-noise-ratio (in decibel) in greater contrast with MF, SMF, and AMF capable of nearly 19.2454±1.5003 dB, 14.8911±3.8296 dB, and 9.0584±2.7019 dB, correspondingly. As results on Pepper figure in Table 4, the widespread outlier extinguish achievement of IMF has a preferable signal-to-noise-ratio (in decibel) in greater contrast with MF, SMF, and AMF capable of nearly 19.2231±1.6427 dB, 14.9649±3.5963 dB, and 8.8716±2.7710 dB, correspondingly. From total experiment results, the achievement of outlier extinguish figures from has preferable signal-to-noise-ratio (in decibel) in outstandingly greater contrast with MF, SMF, and AMF capable as shown in Tables 1-4. From figure quality perspective, the experiment solely exploits sectional experimental results of F16 under FVIN in Figure 2(a) is 70%, Figure 2(b) is 80%, and Figure 2(c) is 90%.



(a)



(b)



(c)

Figure 2. The figure quality experimental results of F16 under FVIN in: (a) 70%, (b) 80%, and (c) 90%

5. CONCLUSION

This academic article focuses to prospect the correlative achievement of the outlier extinguish algorithm established on IMF, which is inaugurated from MF for carrying out the poor achievement of the aforesaid outlier extinguish algorithm, for FVIN at omnipresent scattering of outlier consistency (5-90%). For analyzing the correlative achievement of an outlier extinguish algorithm established on IMF, the analytical experiment exploits on bountiful figures that are unified of F16, Girl, Lena, and Pepper. From total experiment results, the achievement of outlier extinguish figures from IMF has preferable signal-to-noise-ratio (in decibel) in outstandingly greater contrast with SMF, MF, and AMF.

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BIOGRAPHIES OF AUTHORS

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