

# Implementation and Comparative Study of Image Fusion Algorithms

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## ABSTRACT

Image Fusion is a process of combining the relevant information from a set of images, into a single image, wherein the resultant fused image will be more informative and complete than any of the input images. This paper discusses the implementation of three categories of image fusion algorithms – the basic fusion algorithms, the pyramid based algorithms and the basic DWT algorithms, developed as an Image Fusion Toolkit - *ImFus*, using Visual C++ 6.0. The objective of the paper is to assess the wide range of algorithms together, which is not found in the literature. The fused images were assessed using Structural Similarity Image Metric (SSIM) [10], Laplacian Mean Squared Error along with seven other simple image quality metrics that helped us measure the various image features; which were also implemented as part of the toolkit. The readings produced by the image quality metrics, based on the image quality of the fused images, were used to assess the algorithms. We used Pareto Optimization method to figure out the algorithm that consistently had the image quality metrics produce the best readings. An assessment of the quality of the fused images was additionally performed with the help of ten respondents based on their visual perception, to verify the results produced by the metric based assessment. Coincidentally, both the assessment methods matched in their ranking of the algorithms. The Pareto Optimization method picked DWT with Haar fusion method as the one with the best image quality metrics readings. The result here was substantiated by the visual perception based method where it was inferred that fused images produced by DWT with Haar fusion method was marked the best 63.33% of times which was far better than any other algorithm. Both the methods also matched in assessing Morphological Pyramid method as producing fused images of inferior quality.

## Keywords

Image Fusion, Principal Component Analysis, Pyramid Methods, Discrete Wavelet Transform, Image Quality Metrics, Pareto Optimality.

## 1. INTRODUCTION

Any piece of information makes sense only when it is able to convey the content across. The clarity of information is important. Image Fusion is a mechanism to improve the quality of information from a set of images. By the process of image fusion the good information from each of the given images is fused together to form a resultant image whose quality is superior to any of the input images.

This is achieved by applying a sequence of operators on the images that would make the good information in each of the image prominent. The resultant image is formed by combining such magnified information from the input images into a single image.

## 1.1 Evolution of fusion techniques

The evolution of the research work into the field of image fusion [9] [17] [24] [25] [26] can be broadly put into the following three stages.

- Simple Image Fusion
- Pyramid Decomposition based fusion
- Discrete Wavelet transform based fusion

The eleven algorithms implemented and discussed here are such that all the three of the above categories are covered for assessment.

The primitive fusion schemes [9] perform the fusion right on the source images. This would include operations like averaging, addition, subtraction/omission of the pixel intensities of the input images to be fused. These methods often have serious side effects such as reducing the contrast of the image as a whole. But these methods do prove good for certain particular cases wherein the input images have an overall high brightness and high contrast. The primitive fusion methods considered were

- Averaging Method
- Select Maximum
- Select Minimum

With the introduction of pyramid transform [2] [3] [4] [5] [6] [9] in mid-80's, some sophisticated approaches began to emerge. People found that it would be better to perform the fusion in the transform domain. Pyramid transform appears to be very useful for this purpose. The basic idea is to construct the pyramid transform of the fused image from the pyramid transforms of the source images, and then the fused image is obtained by taking inverse pyramid transform. Pyramid transform could provide information on the sharp contrast changes, to which the human visual system is particularly sensitive to and it could also provide both spatial and frequency domain localization. The pyramid fusion methods considered here were

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*15 women who castrated husbands boyfriends and other men ranker* - Jul 15 2023

web sep 23 2021 and for some women like the infamous lorena bobbitt the act of castration is way to take revenge out on the men in their lives sometimes it is solely the testicles that get the axe other times the entirety of the genitals are targeted for revenge sometimes there is a good reason other times the lines are blurred

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web oct 13 2021 castration roleplay my wife started giving me handjobs fairly early on and on two occasions she gave me a special treat by doing some castration roleplay the set up was that i belonged to a small herd of studs kept in a barn by some dominant women that milked them for their sperm my wife told me she had come to do my milking

**milestones the eunuch archive castration is love** - Jun 14 2023

web oct 22 2021 the eunuch archive this is a wonderful resource it s composed of two parts a huge repository of thousands of user submitted castration fantasy stories and a user forum anyone can submit a story but sometimes stories are rejected if there are too many spelling grammatical or formatting errors

**tough revenge 5 women who castrated their boyfriends** - May 01 2022

web tough revenge 5 women who castrated their boyfriends categories history society world by pictolic the case when the threat to tear something off is implemented who how and for what merits in the literal sense of the

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web feb 5 2022 the story of castration of men by women the story of the castration of the husband by the doctor with the details of the procedure the story of castrating young women the story of castrating a young man at a ladies party

**castration of men was based on knowledge of the female body** - Jun 02 2022

web dec 10 2019 the man s testicles and prostate were considered to be the equivalent of the woman s ovaries and uterus says elin björk who recently received her doctorate from the department of thematic

**do women fantasize about castrating a man and would they be** - Dec 08 2022

web we would like to show you a description here but the site won t allow us

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web abstract the eunuch archive ea is an online community which includes individuals who read and write sexual fantasies with themes related to castration and eunuchs here we analyzed the 100 stories rated highest by ea readers among the 8800 currently posted

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web apr 17 2023 judged inferior and punished accordingly ultimate sissy surrender emasculated and stripped dignity a story of emasculation jules helps ashley not every story is for you be kind to your erotic creators f4a and other exciting erotic stories at literotica com

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web nov 15 2020 women have been both agents of castration culture and staunch opponents of castrating their beloved men in wales in 1402 welsh women reportedly mutilated dead english soldiers after the welsh victory in the battle of bryn glas

**castrating humans a guide that you must read mantra care** - Dec 28 2021

web emasculating someone is when you make them weaker by taking away their power a lot of times people will do this to a slave a criminal or a sex offender in modern medicine orchidectomy is one of the most typical methods to treat testicular cancer and it usually involves removing only one testis

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web may 13 2022 only one story featured a female recipient of genital ablation table 1 which was performed by a male the remaining stories featured male protagonists the castratee s age was specified in 57 stories and ranged from 8 to 39 m 19 1 sd 6 1 with the most common age specified as 19 in nine stories legally adult in most

*june 2021 castration is love* - Sep 05 2022

web jun 21 2021 over the years women got more equality with men but the sisterhood were still at work over the years women of the sisterhood were in positions of power and influence their agents infiltrated government the military and the

police force they rigged elections and assassinated male candidates

castratrix quarterly a bounty hunter for testicles by cait b - Aug 16 2023

web feb 9 2022 during this the men of the realm were gathered together and separated into two groups by the women the smaller group was the stud group they kept their balls and were slaves to their sex and dominance drives they were kept for if and when any woman might want an old fashion mating

**freedom and the widow ch 16 bdsm literotica com** - Mar 11 2023

web nothing arouses a woman like the prospect of castrating a man you now smell the arousal of a woman who is going to realise that ambition and will thoroughly enjoy doing so my nurses will inject your sack and then your mistress will milk you one final time

*the sexual side of castration narratives fiction written by and for* - Jul 03 2022

web aug 1 2015 castration is the destruction of the testicles or their complete removal medically referred to as an orchietomy while penectomy refers to total or partial surgical removal of the penis the ea contains four sections a chat room personals discussion board and the fiction archive

**what i m really thinking the castrated man the guardian** - Mar 31 2022

web aug 1 2015 anonymous n early two years ago i sat in a hospital consulting room following a prostate examination and body scan it s not good news the doctor said you have three choices