



# Feature Visualisation of CNN

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# Overview



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**01. Introduction**

**02. Methodology**

**03. Results and Conclusions**

# Introduction

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# Motivations

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- Convolutional neural networks (CNNs) have been widely used in Computer Vision field.
- CNNs become more and more opaque.
- A growing sense that networks need to be interpretable for humans.
- Feature visualisation is one of the most powerful tools to understand the black-box neural networks.



# Objectives

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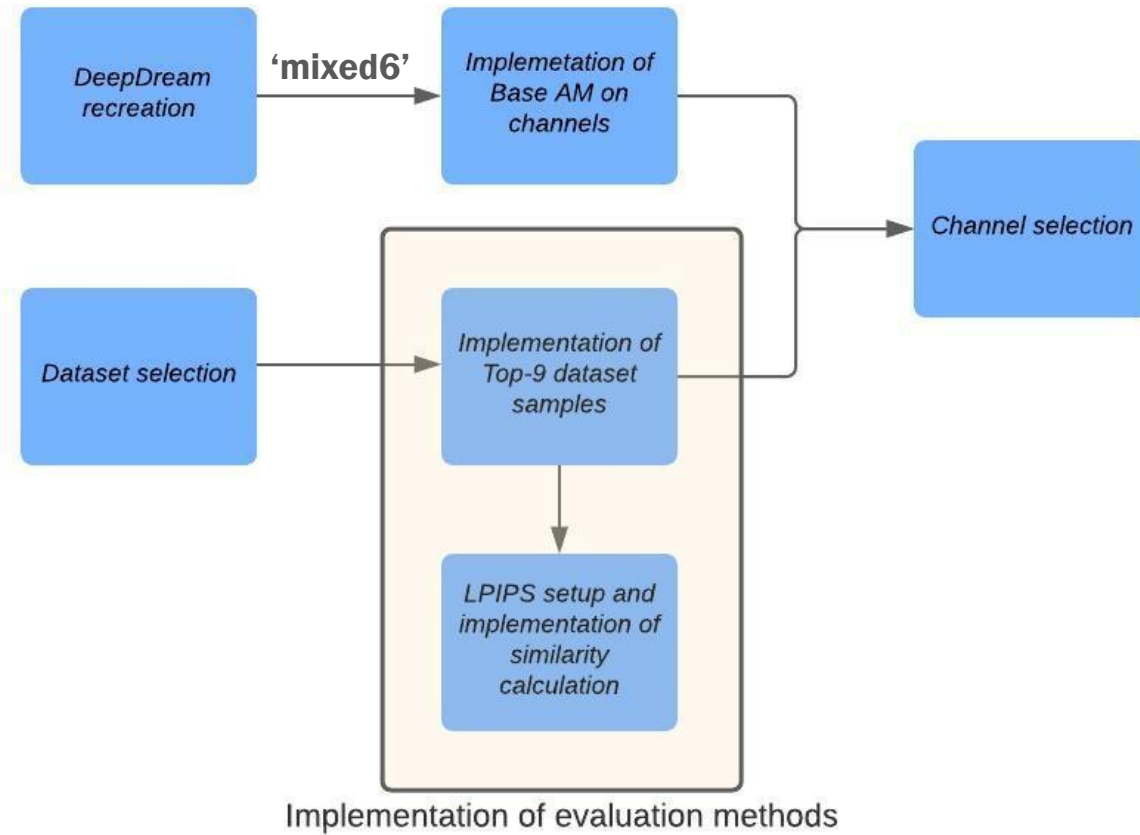
- Implemented feature visualisation via Activation Maximization (AM) channel-wise to reflect what a certain channel is doing.
- Applied several regularisation methods on AM.
  - L2
  - Total variance
  - Transformation robustness (jitter, scale, rotate)
  - Octaves scale-up
- Evaluated the effect of different regularisations along with their corresponding parameters quantitatively.
- Proposed a refined range of values for each tested parameter.



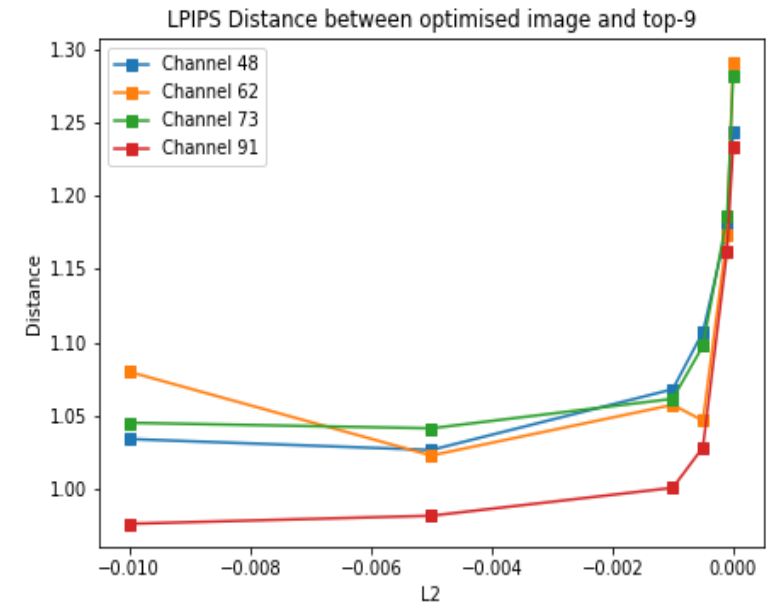
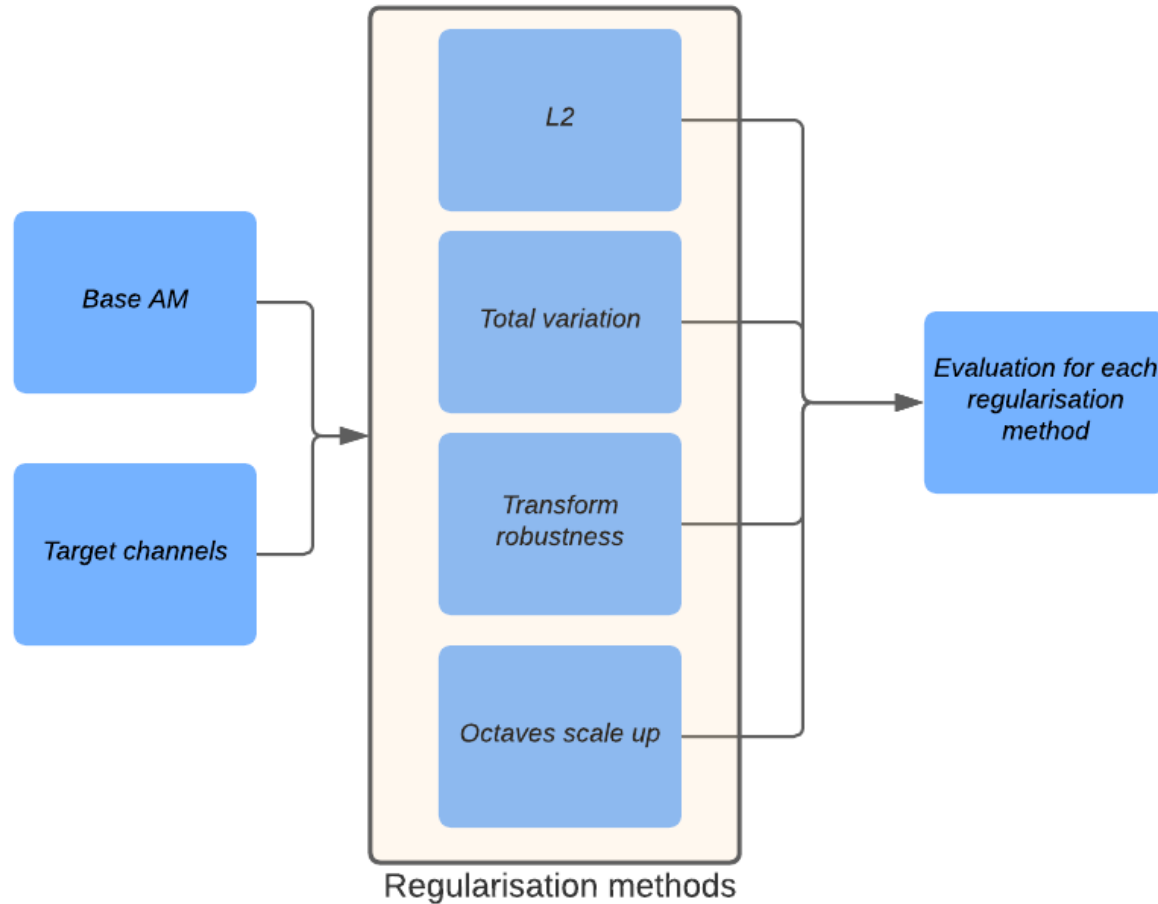
# Methodology

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# Implementation phase



# Experiment phase





# **Results and Conclusions**

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# Results

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Refined range of potential values for each tested parameter

Experiment	Potential parameter range
L2	(-0.01, -0.001)
Total variance	(-0.001, -0.0001)
Transformation: Jitter	(8, 64)
Transformation: Scale	(1.0, 1.4)
Transformation: Rotate	(15, 180)
Octaves scale up	(1.0, 1.2)

# Results

The lowest LPIPS of AM images generated with different regularisations for 4 chosen channels.

Experiment	Channel 48	Channel 62	Channel 73	Channel 91
No regularisation	1.244	1.292	1.282	1.234
L2	1.026	1.023	1.041	0.976
Total variance	<b>0.798</b>	<b>0.742</b>	<b>0.778</b>	<b>0.763</b>
Standard transformation	0.901	0.888	0.883	0.849
Transformation: Jitter	0.906	0.915	0.924	0.906
Transformation: Scale	0.836	<b>0.736</b>	0.829	0.819
Transformation: Rotate	0.959	1.047	1.055	1.028
Octaves scale-up	<b>0.717</b>	0.773	<b>0.818</b>	<b>0.780</b>

# Conclusions

- All regularisation methods have positive effect on the results to varying degrees
- Both of total variance and octaves scale-up improve the AM image by around 39% in average
- L2 has the least positive effect on the results (with an average improvement of 19.5%)

Experiment	Channel 48	Channel 62	Channel 73	Channel 91	
No regularisation	1.244	1.292	1.282	1.234	
L2	1.026	1.023	1.041	0.976	19.5%
Total variance	<b>0.798</b>	<b>0.742</b>	<b>0.778</b>	<b>0.763</b>	39.0%
Standard transformation	0.901	0.888	0.883	0.849	
Transformation: Jitter	0.906	0.915	0.924	0.906	
Transformation: Scale	0.836	<b>0.736</b>	0.829	0.819	
Transformation: Rotate	0.959	1.047	1.055	1.028	
Octaves scale-up	<b>0.717</b>	0.773	<b>0.818</b>	<b>0.780</b>	38.8%

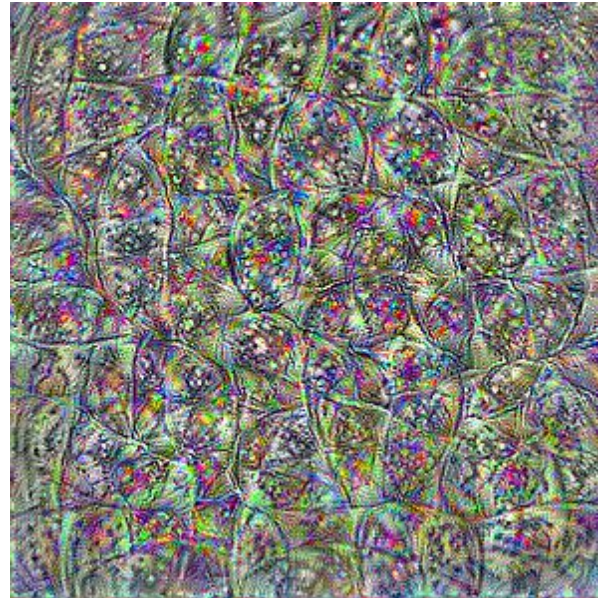


# Thank you

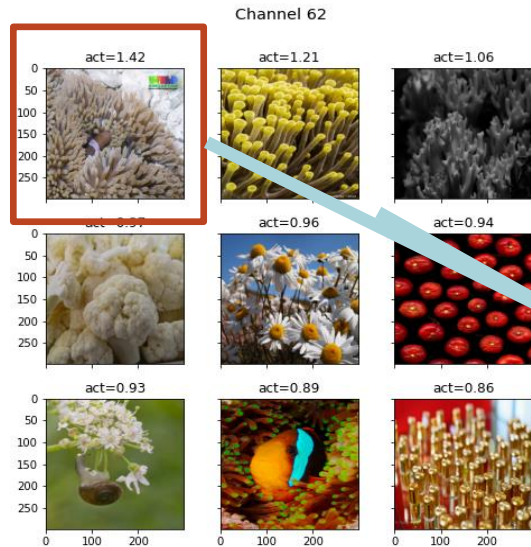
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Thanks to your patience and support.

# Base AM (channel 0)



# Similarity calculation



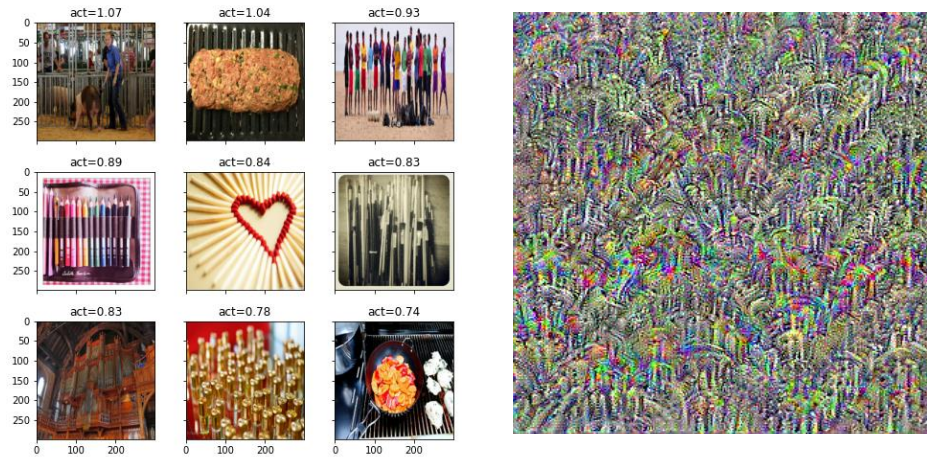
LPIPS

Perceptual  
similarity



# Channel selection (channel 48,62,73,91)

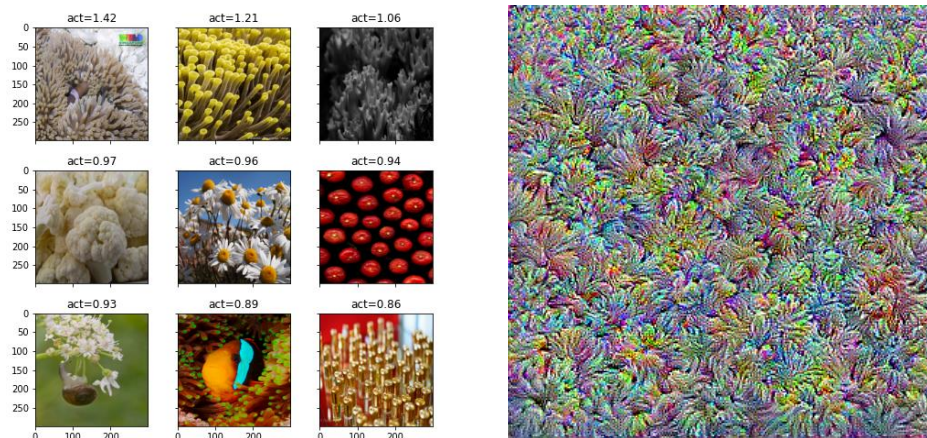
## Channel 48



## Channel 73



## Channel 62



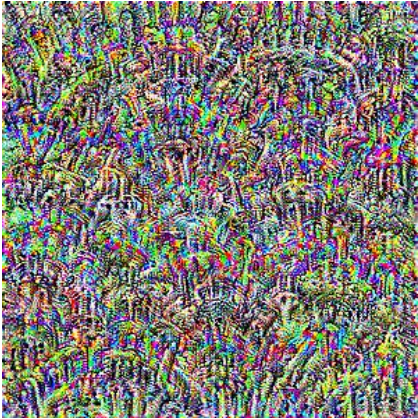
## Channel 91





# Experiment results (channel 48)

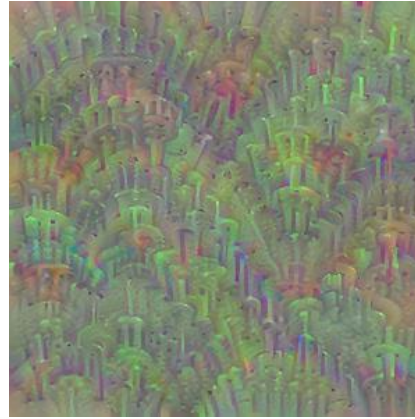
Reference



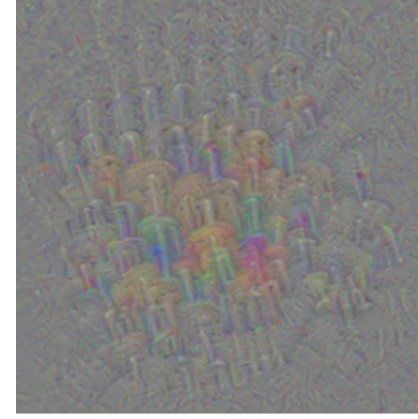
L2,  $\lambda_{L_2} = -0.005$



TV,  $\lambda_{tv} = -0.005$



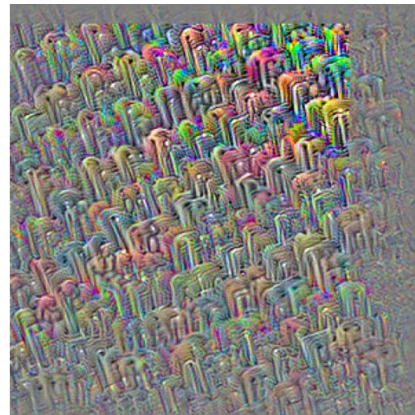
Standard transformation



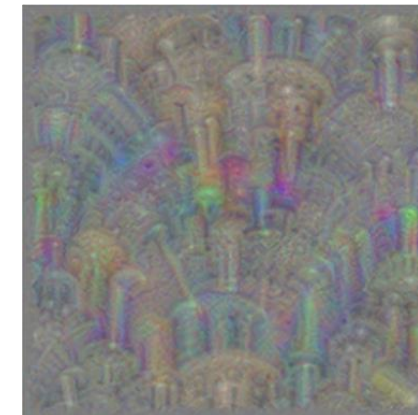
Octaves scale-up, octave\_scale= 1.1



Transformation jitter = 16



Transformation scale = 1.2



Transformation rotate = 45

