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# Signal filtering - application in agriculture

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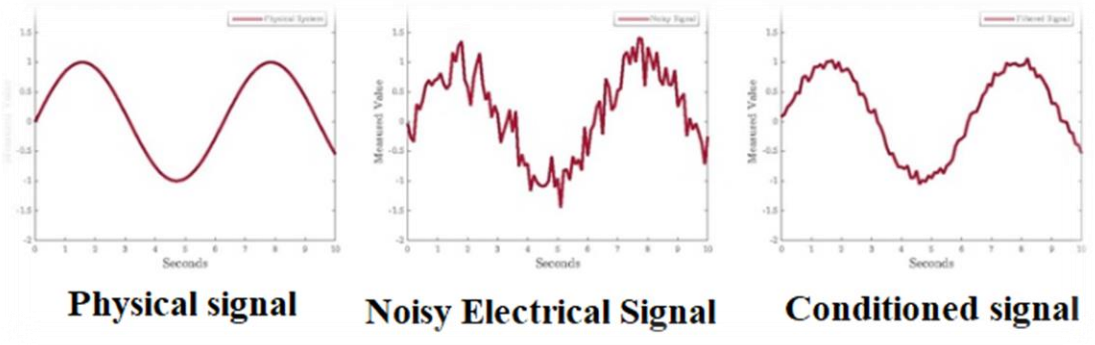
# What is a signal?

- A signal is a set of information of data

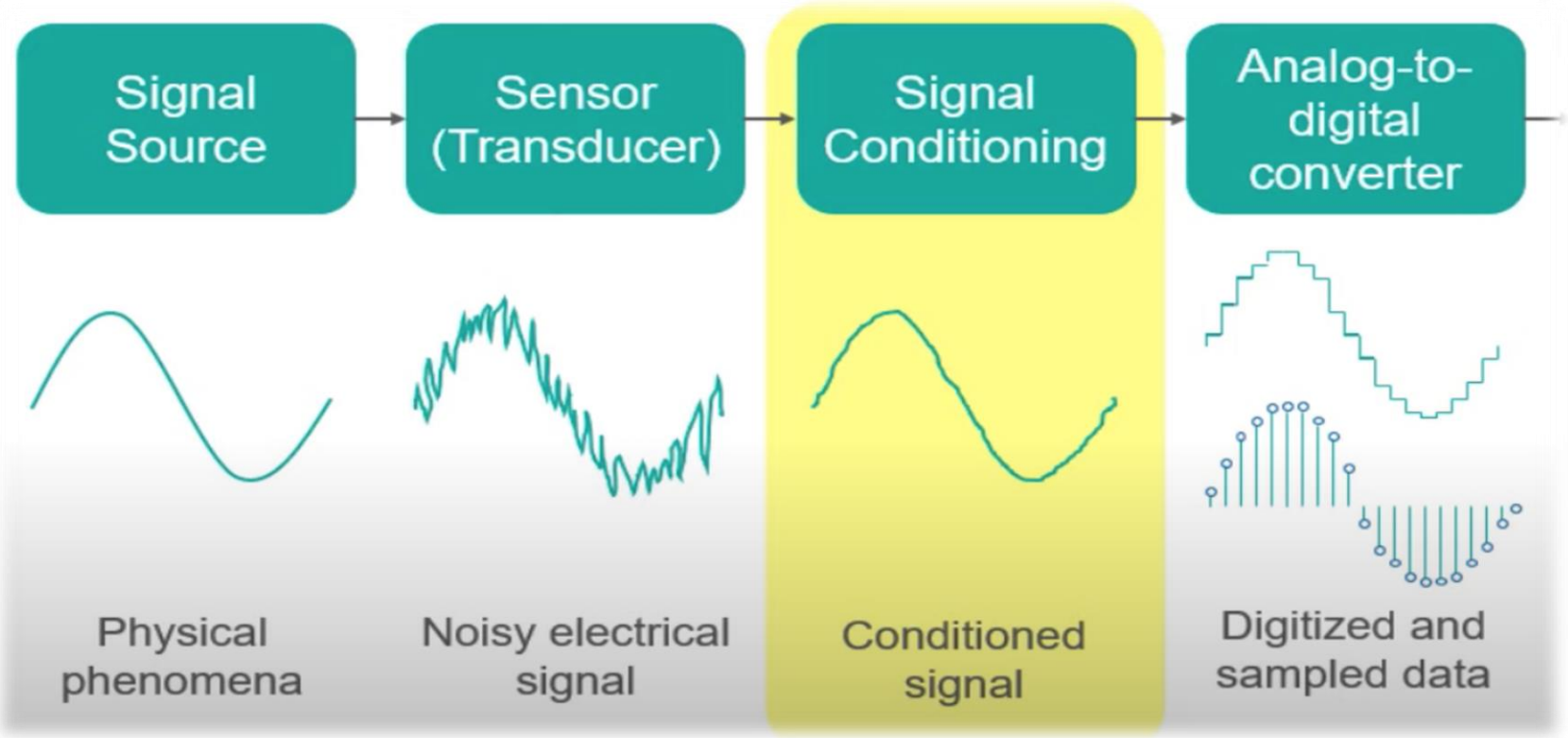



[1]

- During information acquisition, signal quality is often degraded

# Acquisition problems

- Sound degradation caused by noise or quality of sensor
- Image degradation caused by blur, noise or sensor quality
  - Noise is arbitrary alternation of brightness and colour




[2]

# Signal filtering

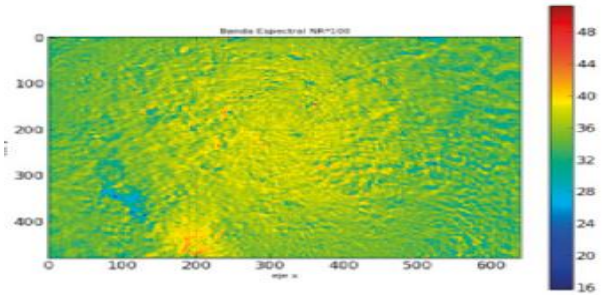
- Filtering is the operation of rejecting undesired signal features, while maintaining desired ones


a)

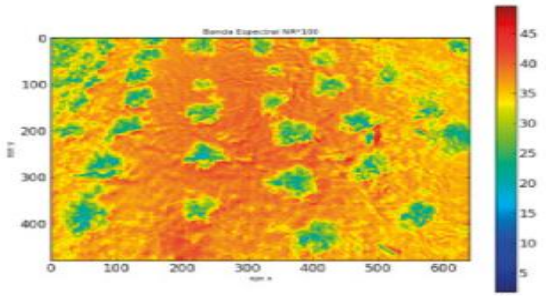

b)


c)


d)



e)

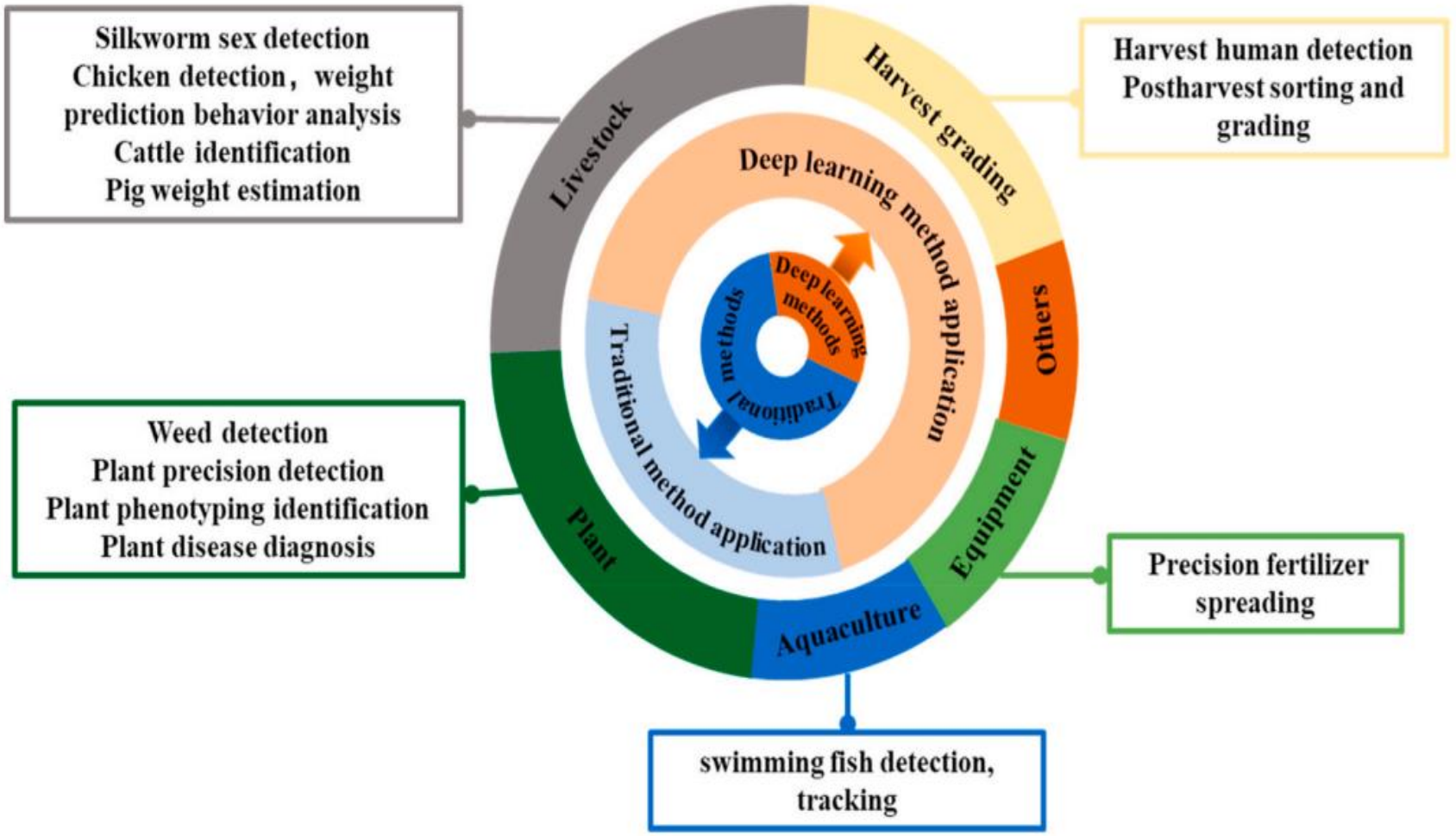


f)

[3]

Would this detection be possible if image quality was distorted?

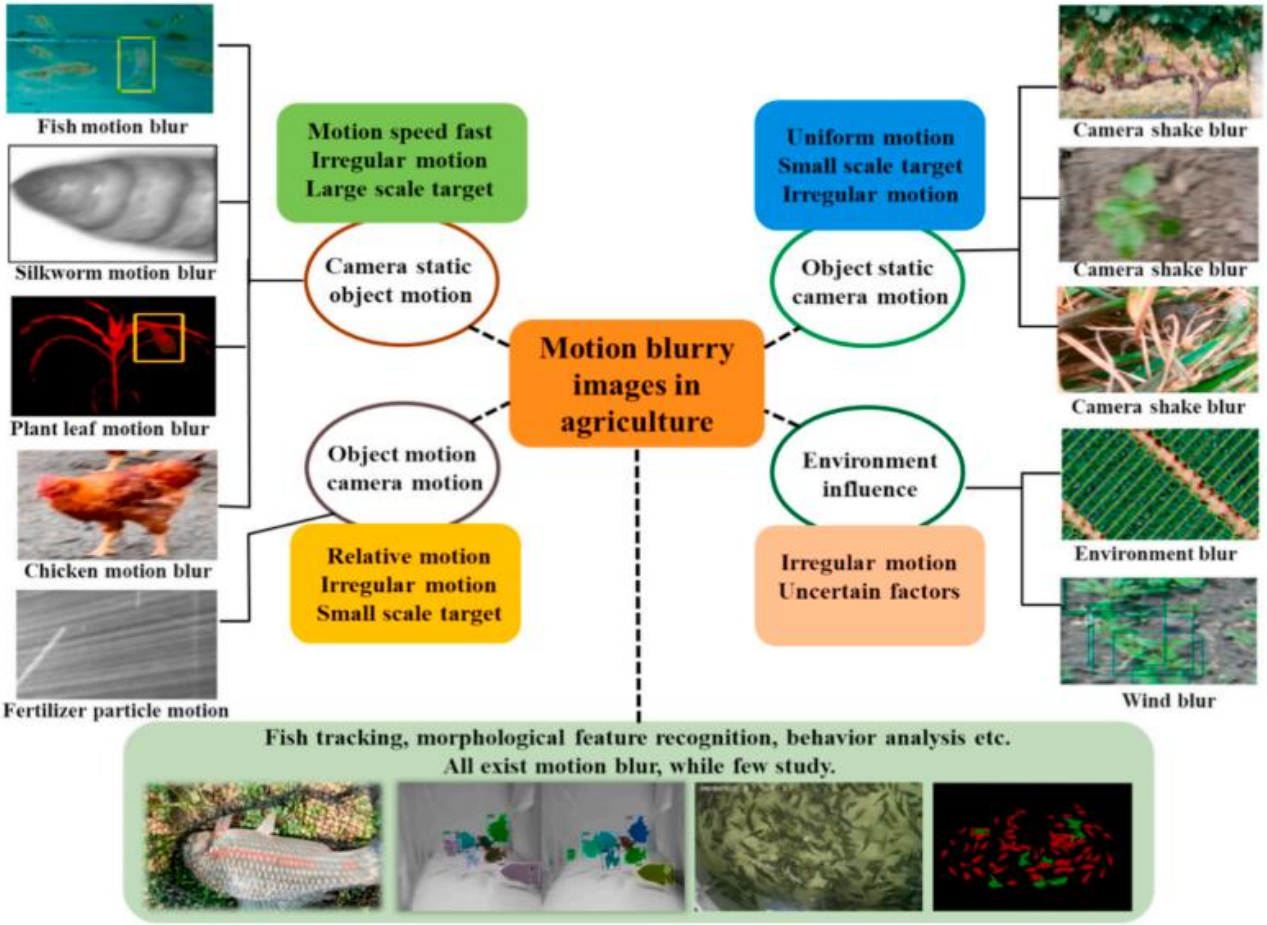
# Image filtering in agriculture




[5]

# Image filtering in agriculture

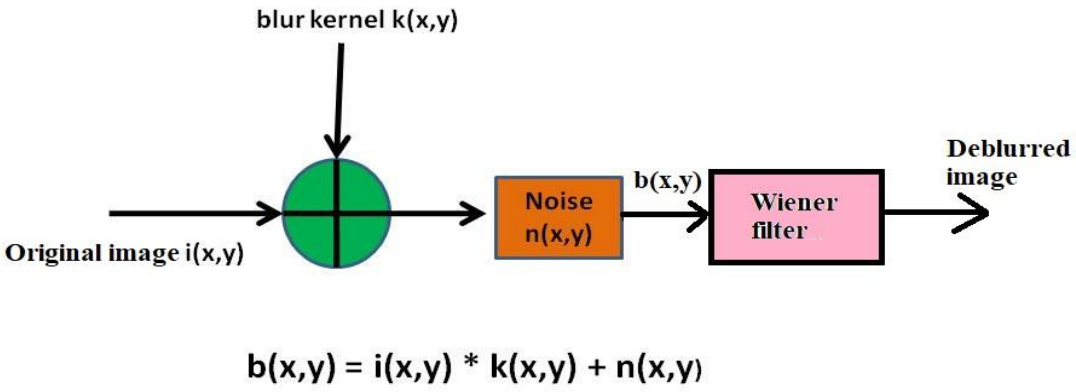
- Application in plant disease diagnose, fruit sorting and grading, livestock monitoring, mechanized fertilization...




[4]

# Wiener filtering method

- Wiener filter as a non-blind method is the most common deblurring algorithm
- It is recommended for situations that the image is degraded by noise, motion blur, and unfocused optics blur or linear blur

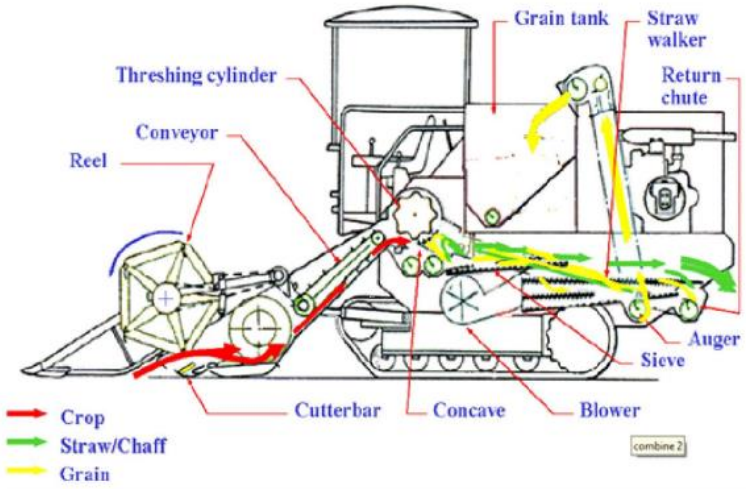



$$b(x,y) = i(x,y) * k(x,y) + n(x,y)$$

[6]

# Image deblurring in wheat combine harvester

- Grain conditions inside tank can be monitored online using machine vision and digital image processing system
- Obtained information can be used to adjust related parts of the combine such as threshing drum speed or distance between threshing drum and concave



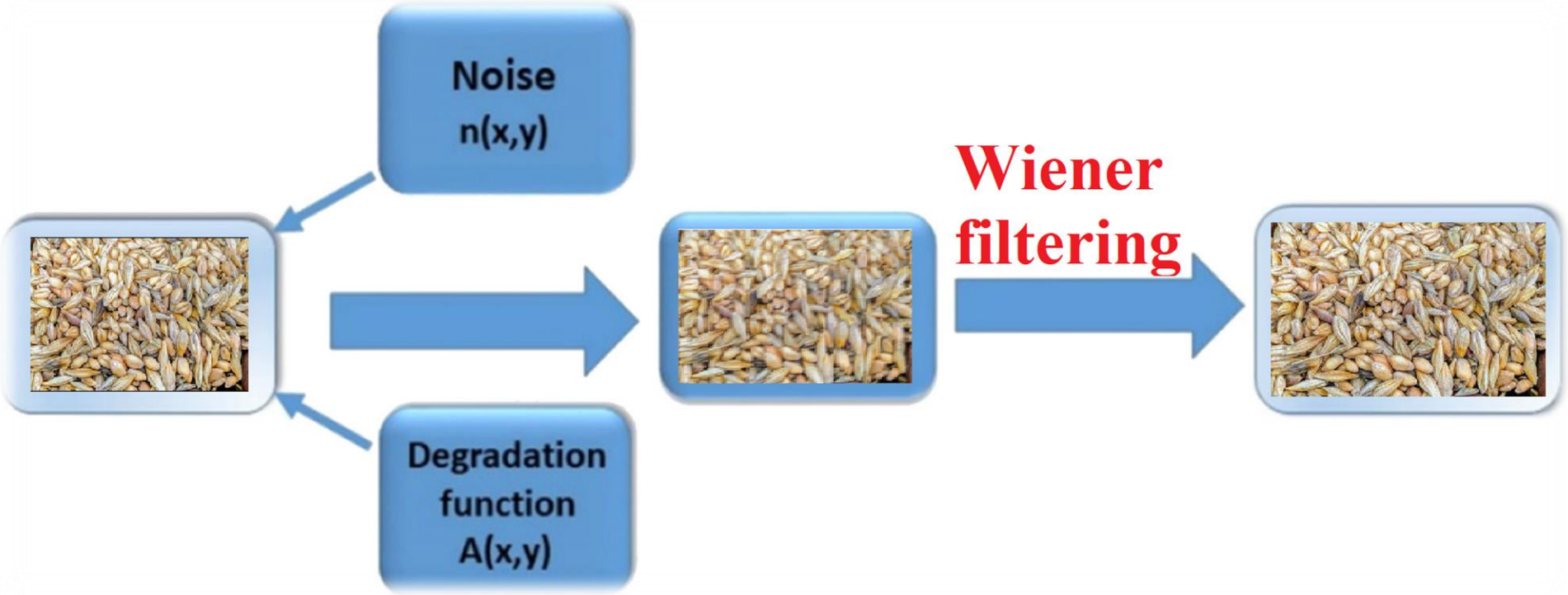

[7]

# Image deblurring in wheat combine harvester

- Unwanted vibrations occur during wheat harvesting for several reasons: engine vibrations, power transmission system, reciprocating movement of the sieves and wheat-land roughness
- Most important degradation of image is blurring, combined with presence of noise

Blurred image acquired from inside of combine harvester tank

# Image deblurring in wheat combine harvester




[8]

# Image deblurring in wheat combine harvester

- Vibration monitoring during harvesting process using accelerometer sensors installed on the combine harvester tank

Image deblurring using perfect vibration pattern assessment

# Image deblurring in wheat combine harvester

Image deblurring using actual assessment of vibration pattern in real conditions

# Image deblurring in wheat combine harvester

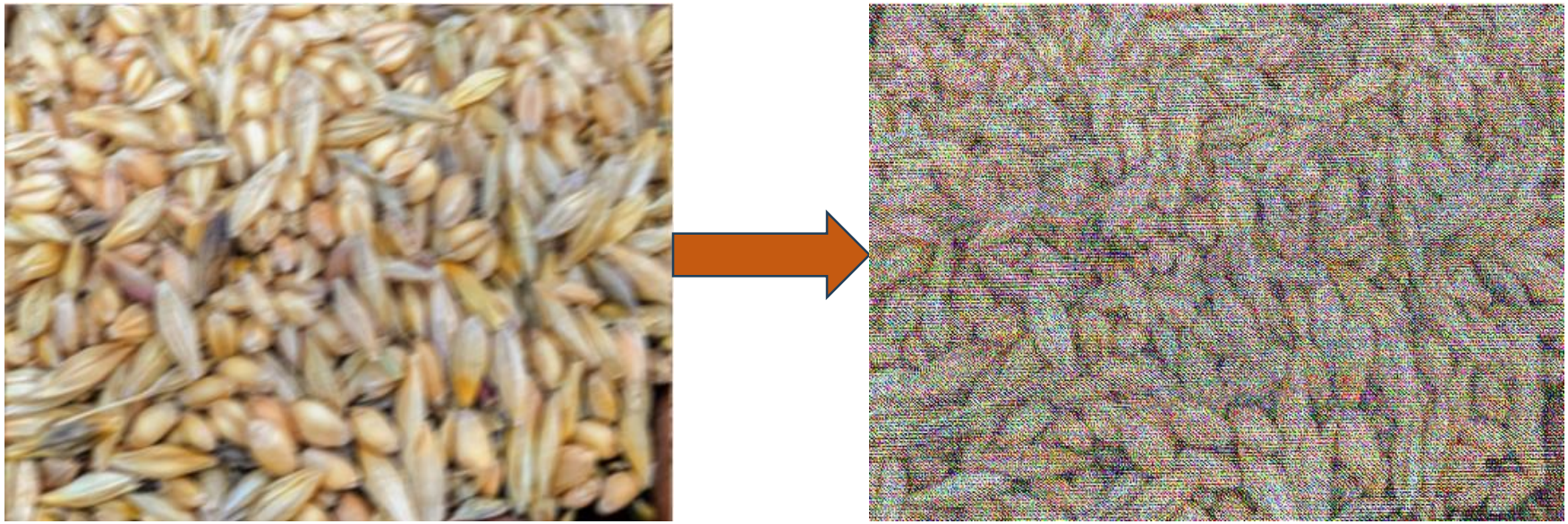


Image deblurring with wrong assessment of random noise statistical characteristics

# Conclusion

- Real-world agricultural settings often present complex challenges such as fast animal movement, equipment vibrations and environmental influences which can cause motion-blurred images and reduce effectivness of computer vision and image processing technologies

- Image motion deblurring and noise removal has proved itself as important method in enhancing the capabilities of agricultural image analysis

# Thank you for your attention!

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