

# HDR WITH RASPBERRY PI

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# Motivation

- **Why?**

- combine low dynamic range (LDR) images into an high dynamic range (HDR) image where very dark and very bright regions in a scene can be seen simultaneously with clarity and high resolution

- **How?**

- building a cheap and easy hardware setup
- capture images
- optional: perform some image processing, e.g. denoising, deblurring, ...

- **Applications?**

- medical
- digital cinema
- security, e.g. entrances to buildings
- computer games
- design

# Introduction

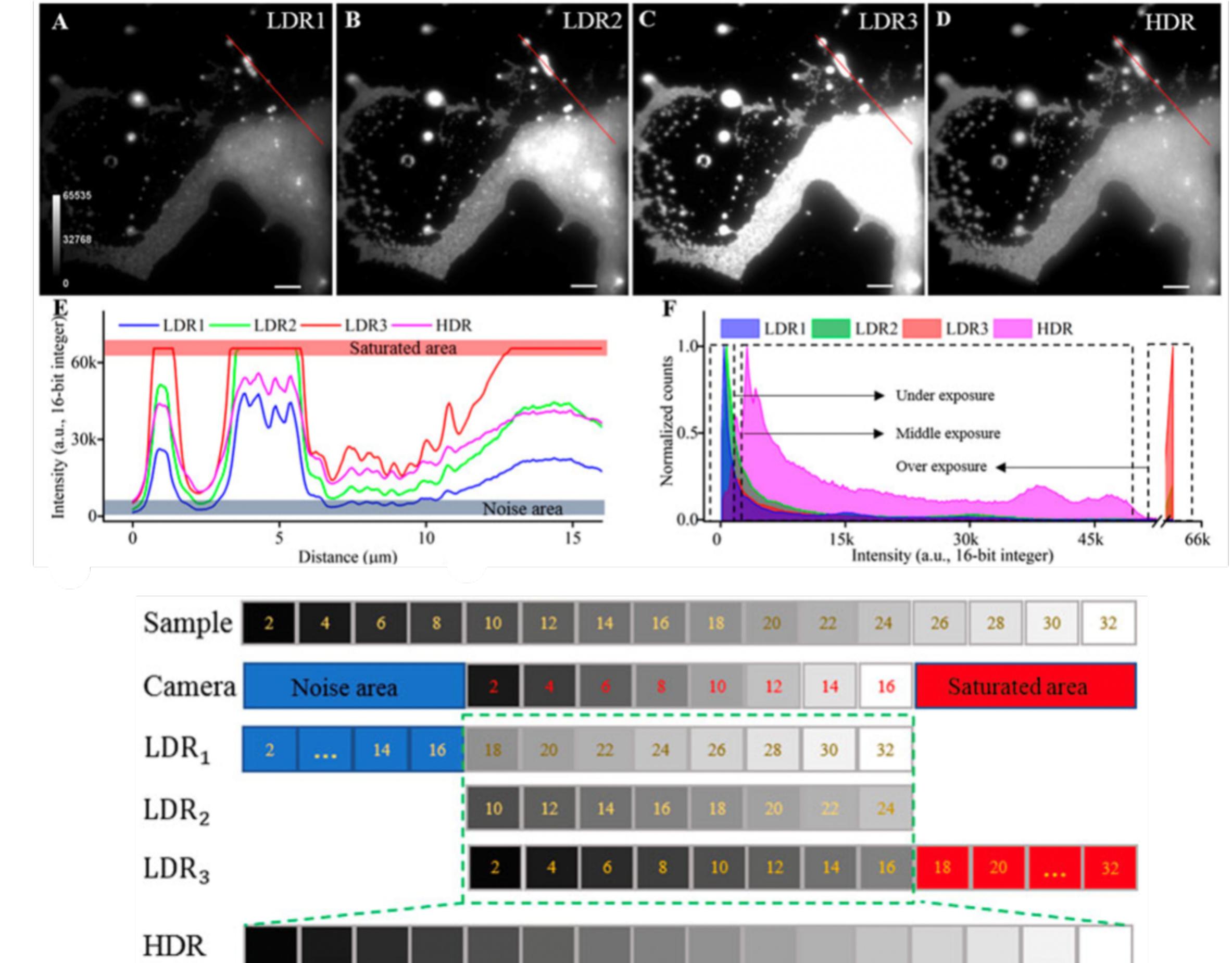
Liang et al, Front. Phys. 9, 648174 (2021)

- **Dynamic Range**

- it is the ratio between the maximum and minimum measurable light intensities (white and black)

- **HDR**

- imaging technique to increase the dynamic range
- by capturing multiple images (of the same scene) but with different exposures and then combining them into one image.



# HDR with Raspberry pi

- **Aim of project**

- increase dynamic range of images taken with a raspberry pi camera

- **Setup**

- For a normal scene
    - 6mm wide angle objective + Raspberry Pi HQ camera (total price is less than 100€)
  - For a microscopic scene
    - a microscope (could start around 100€) + Raspberry Pi HQ camera

- **Tasks**

- capture images with different exposures
    - in case you want to fast-forward the project and have a set of input images to test:  
<https://www.pauldebevec.com/Research/HDR/>
    - two options: either change intensity of light or camera shutter speed (latter is preferred!)
    - use python or MATLAB to combine the raw images into an HDR
      - others: command line tools, e.g. pfstools, LuminanceHDR



# Links and Further reading

- Raspberry Pi HQ camera
  - <https://www.raspberrypi.com/products/raspberry-pi-high-quality-camera/>
  - <https://www.raspberrypi.com/news/new-autofocus-camera-modules/>
- wide angle lens
  - [https://www.reichelt.de/raspberry-pi-objektiv-fuer-cs-fassung-6mm-weitwinkel-rpiz-cam-6mm-ww-p276922.html?PROVID=2788&gclid=CjwKCAjw586hBhBrEiwAQYEnHXKdmtXDZ63g2edtwXrp-RVRA6alwOhGvrW1QkOQ0xmScwRo9k2EBBoCUSwQAvD\\_BwE](https://www.reichelt.de/raspberry-pi-objektiv-fuer-cs-fassung-6mm-weitwinkel-rpiz-cam-6mm-ww-p276922.html?PROVID=2788&gclid=CjwKCAjw586hBhBrEiwAQYEnHXKdmtXDZ63g2edtwXrp-RVRA6alwOhGvrW1QkOQ0xmScwRo9k2EBBoCUSwQAvD_BwE)
- Swift microscope
  - [https://www.amazon.com/-/de/dp/B07PCHV4NY?linkCode=ssc&tag=onamzton03-20&creativeASIN=B07PCHV4NY&asc\\_item\\_id=amzn1.idea.1YPPTVIUMJE1C&ref\\_=aip\\_sf\\_list\\_spv\\_ofs\\_d\\_asin&th=1](https://www.amazon.com/-/de/dp/B07PCHV4NY?linkCode=ssc&tag=onamzton03-20&creativeASIN=B07PCHV4NY&asc_item_id=amzn1.idea.1YPPTVIUMJE1C&ref_=aip_sf_list_spv_ofs_d_asin&th=1)
- PFSTools
  - <https://pfstools.sourceforge.net/>
- LuminanceHDR
  - <https://qtpfsgui.sourceforge.net/>
- An intro to HDR with python code examples
  - <https://roboalgorithms.com/posts/camera-response-function/>

# Thank You!

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