

Lecture 01 – Introduction to image processing

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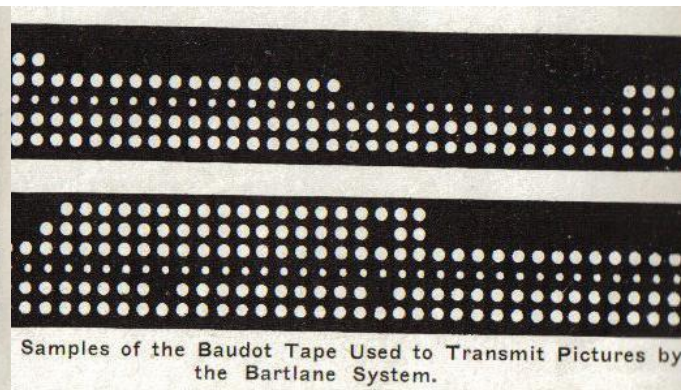
- The Bartlane system
- The space program
- O electromagnetic spectrum
- Image processing in Brazil
- An application of image processing
 - Computer tomography

The Bartlane system

- One of the first applications of digital images
- Used to send digital images through submarine cable between London and New York
- It has reduced the time to send a photo across the Atlantic Ocean from over a week to less than three hours
- One equipment encoded the images for the cable transmission and the latter reconstruct them on the receiving
- No image processing occurs

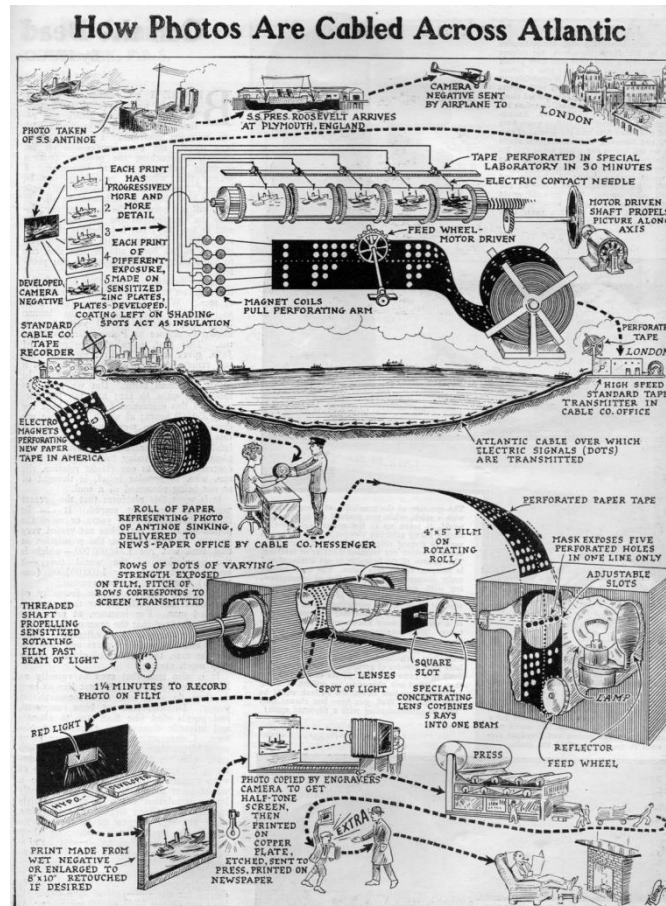


The Bartlane Transmitter.

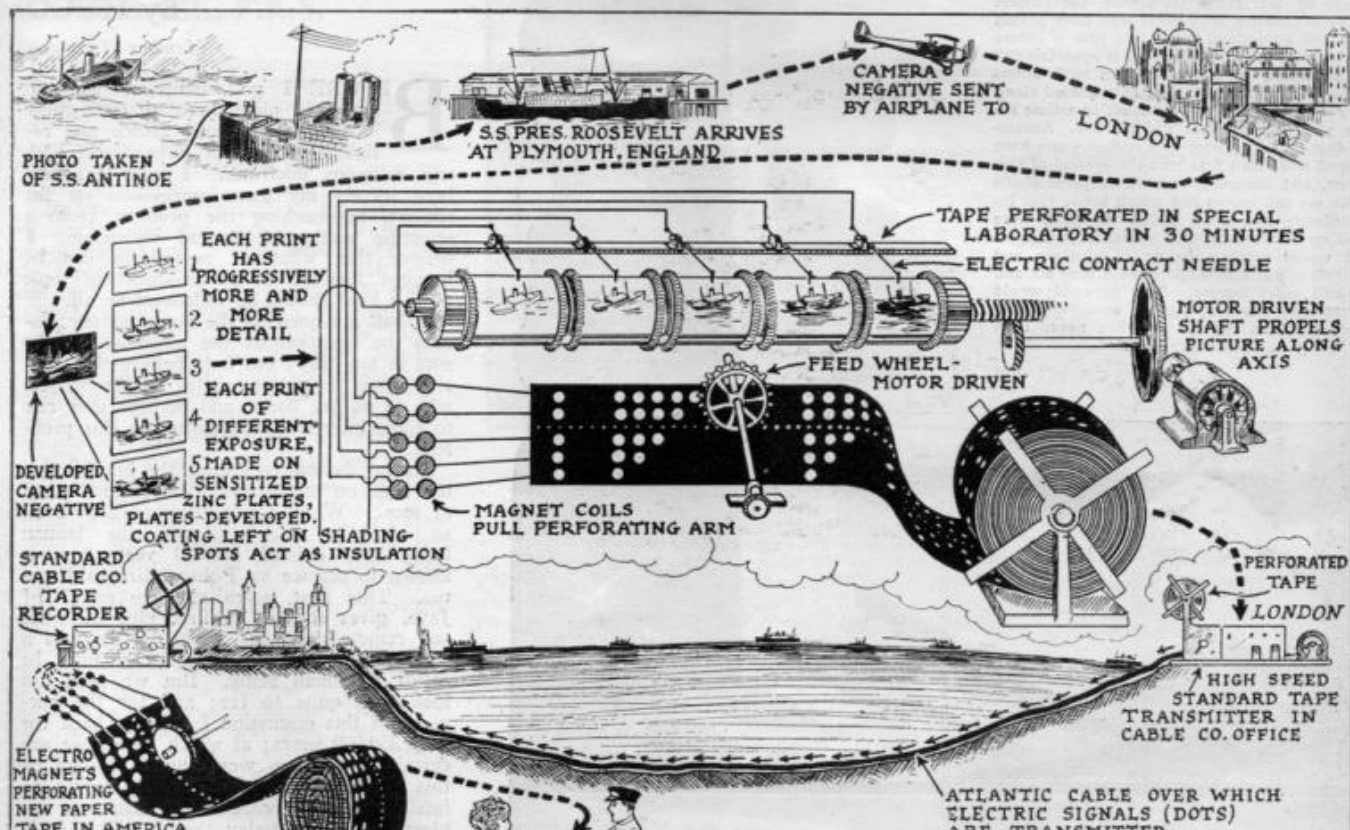
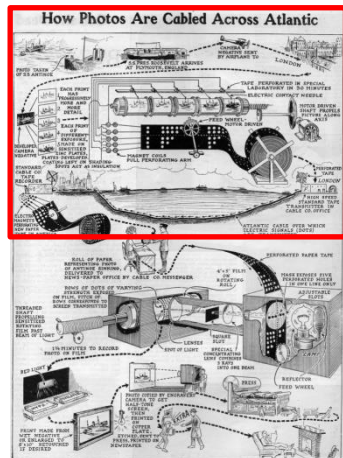


Samples of the Baudot Tape Used to Transmit Pictures by the Bartlane System.

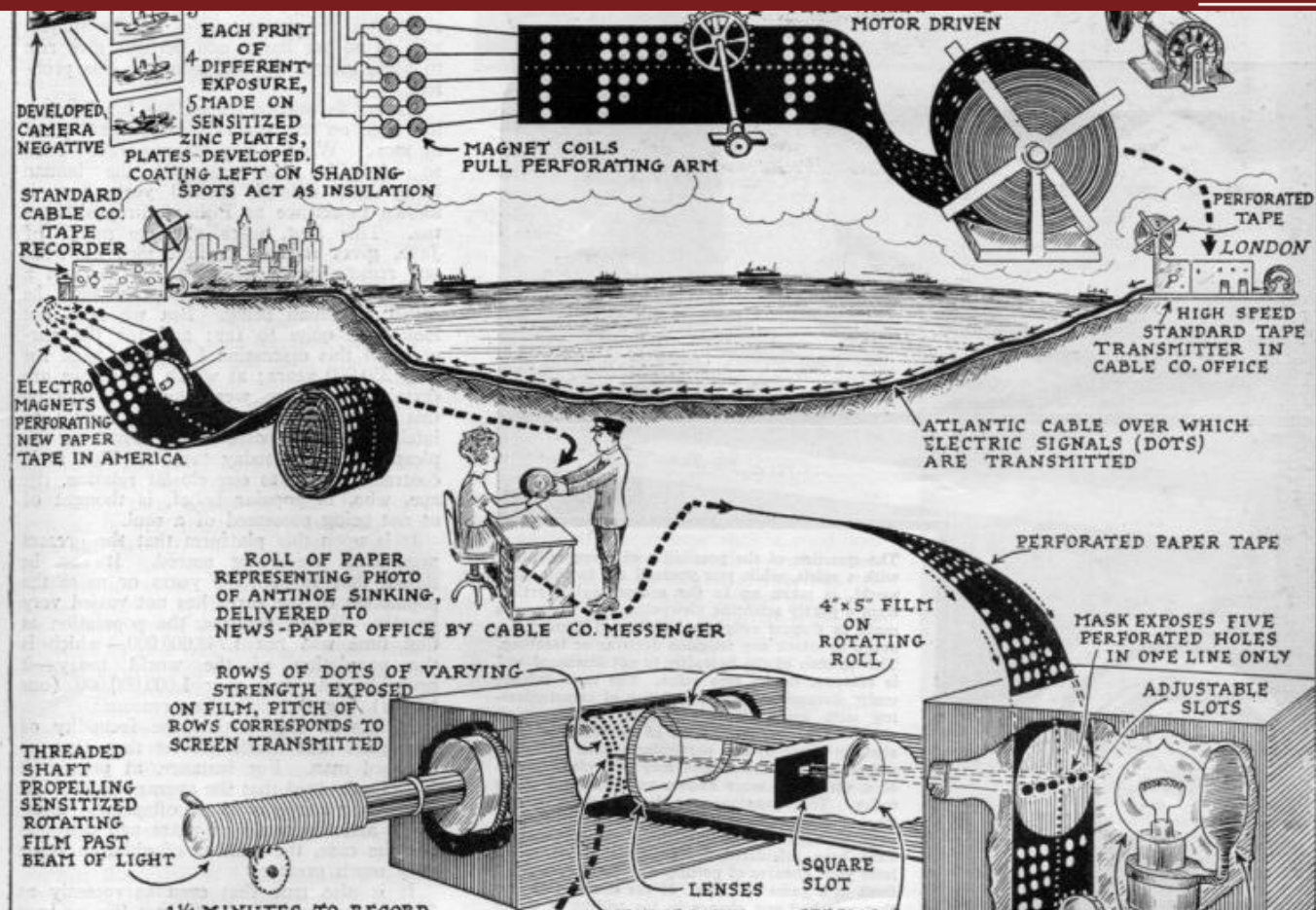
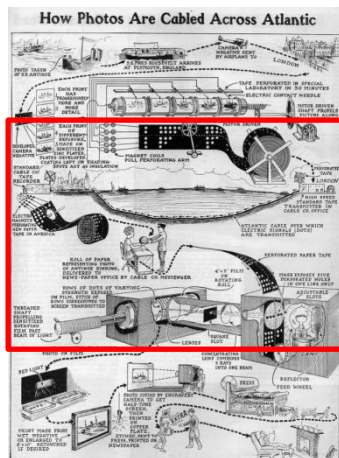
<http://www.hffax.de/history/html/bartlane.html>



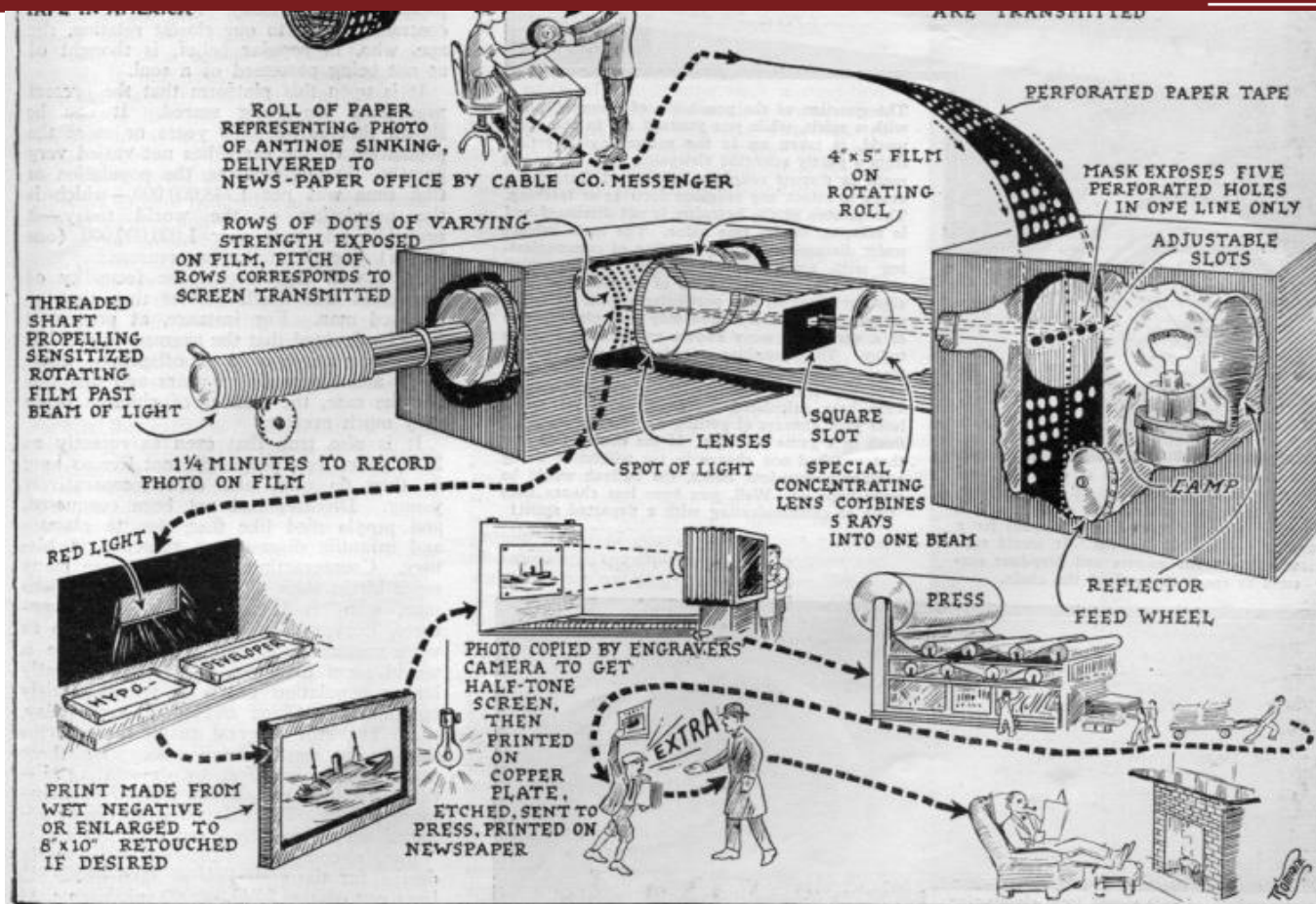
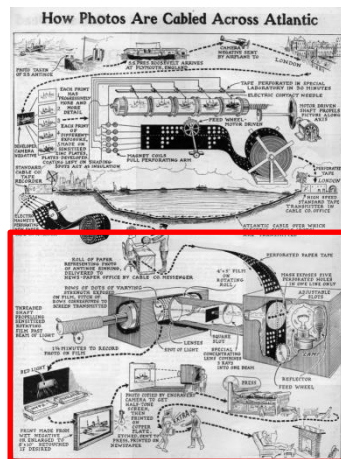
How Photos Are Cabled Across Atlantic



The Bartlane system



The Bartlane system



The space program

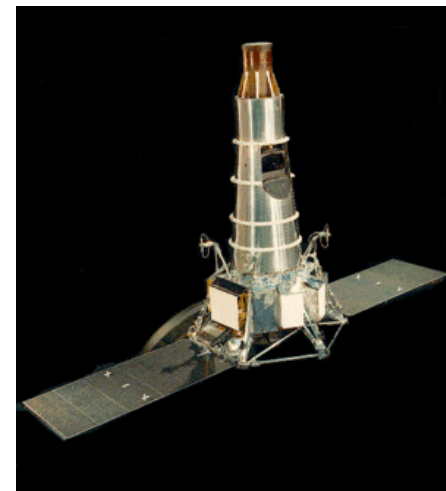
- JPL – Jet Propulsion Lab (Pasadena, California), 1964
- Ranger 7
 - Sonda espacial Ranger enviada para fotografar a Lua
 - Imagens eram obtidas por câmeras de televisão
 - Enviadas para a Terra por ondas de rádio
 - Necessidade de processar as imagens
 - Melhorar a qualidade das imagens
 - Obter a maior quantidade de informação possível
- Video Film Converter
 - Desenvolvido para converter os sinais de vídeo analógicos para imagens digitais
- Computador NCR 102D
 - Usado para processar as imagens digitais
 - Ajuste de contraste
 - Normalização da iluminação
 - Remoção da imagens residual proveniente de capturas anteriores
 - Remoção de ruído de transmissão
 - Correções geométricas usando marcas reseau.

The space program

- First image of the moon taken by the Ranger 7.
- July 31, 1964
- About 17 minutes before the impact in the lunar surface.



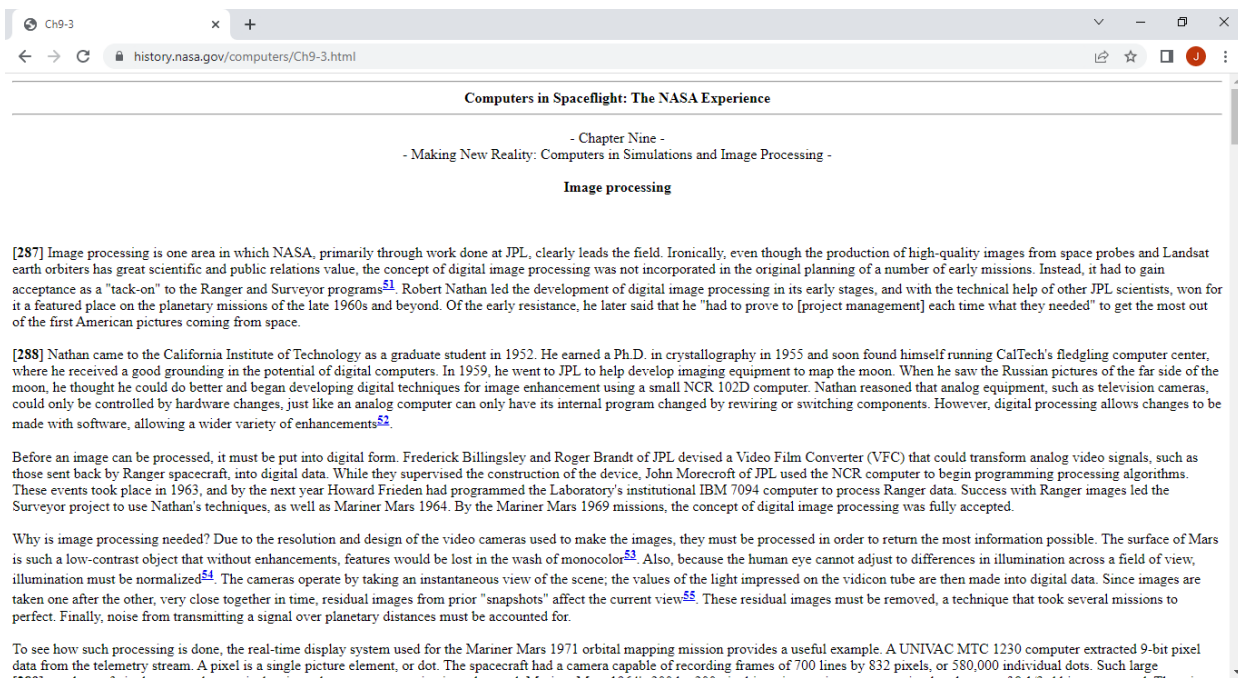
The Ranger 7 probe.



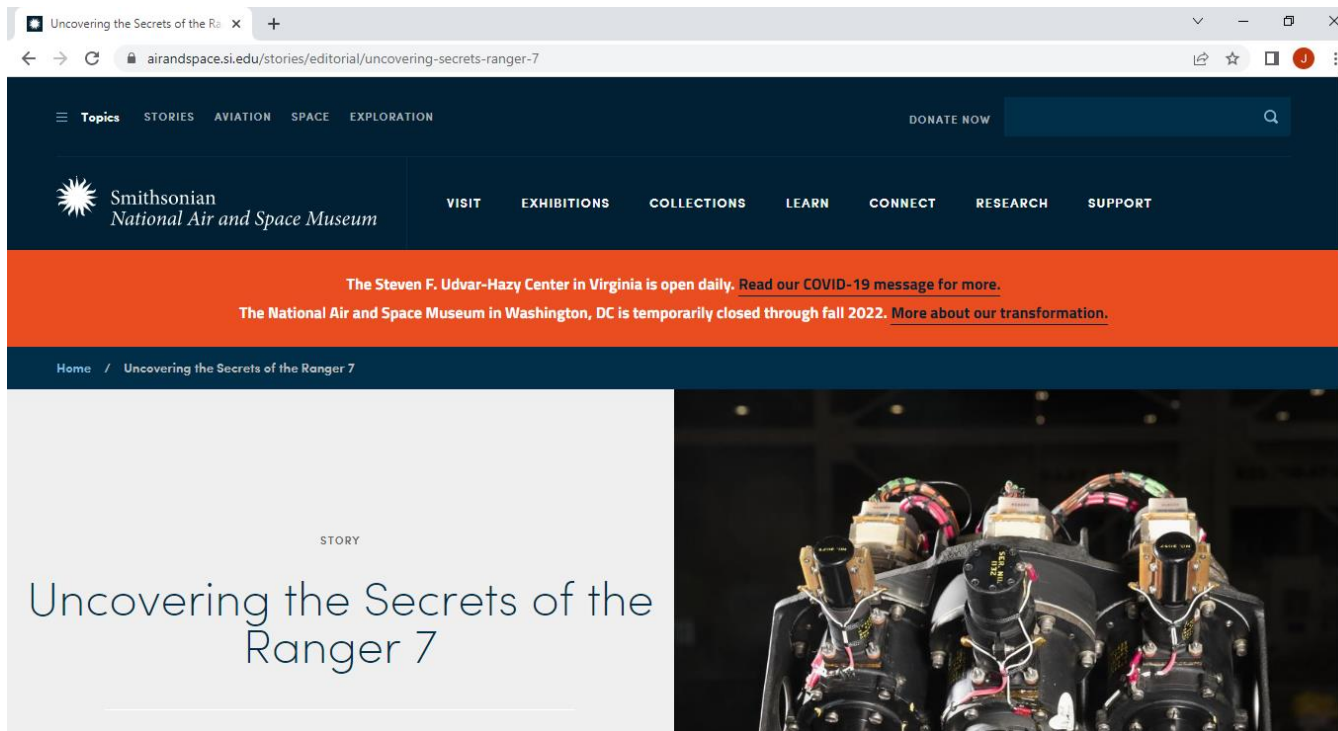
https://pt.wikipedia.org/wiki/Ranger_7

The space program

- Computers in Spaceflight: The NASA Experience.
 - Chapter Nine. Making New Reality: Computers in Simulations and Image Processing.
 - <https://history.nasa.gov/computers/Ch9-3.html>



- Matthew Shindell. Uncovering the Secrets of the Ranger 7. July 31, 2018
 - <https://airandspace.si.edu/stories/editorial/uncovering-secrets-ranger-7>

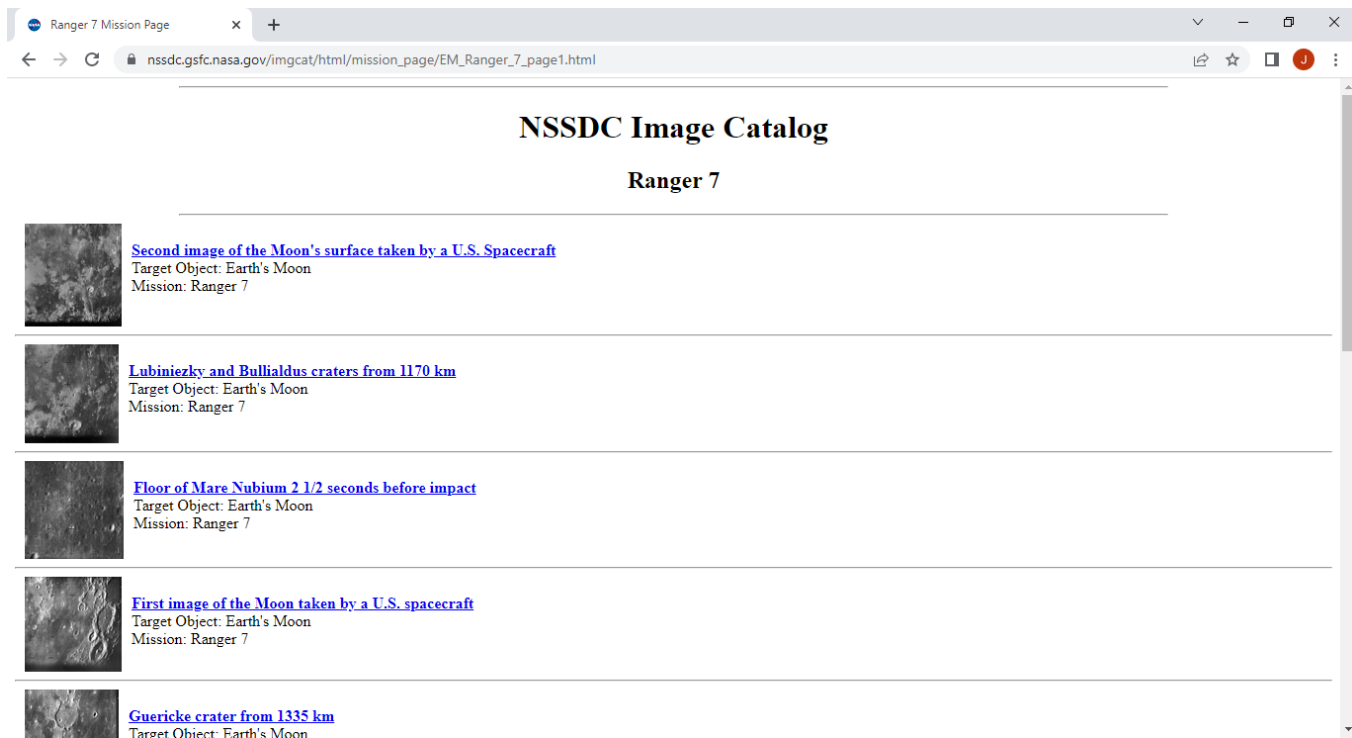


- US: Ranger 7 - 1964
 - <https://www.youtube.com/watch?v=QGJbybcXd0c>

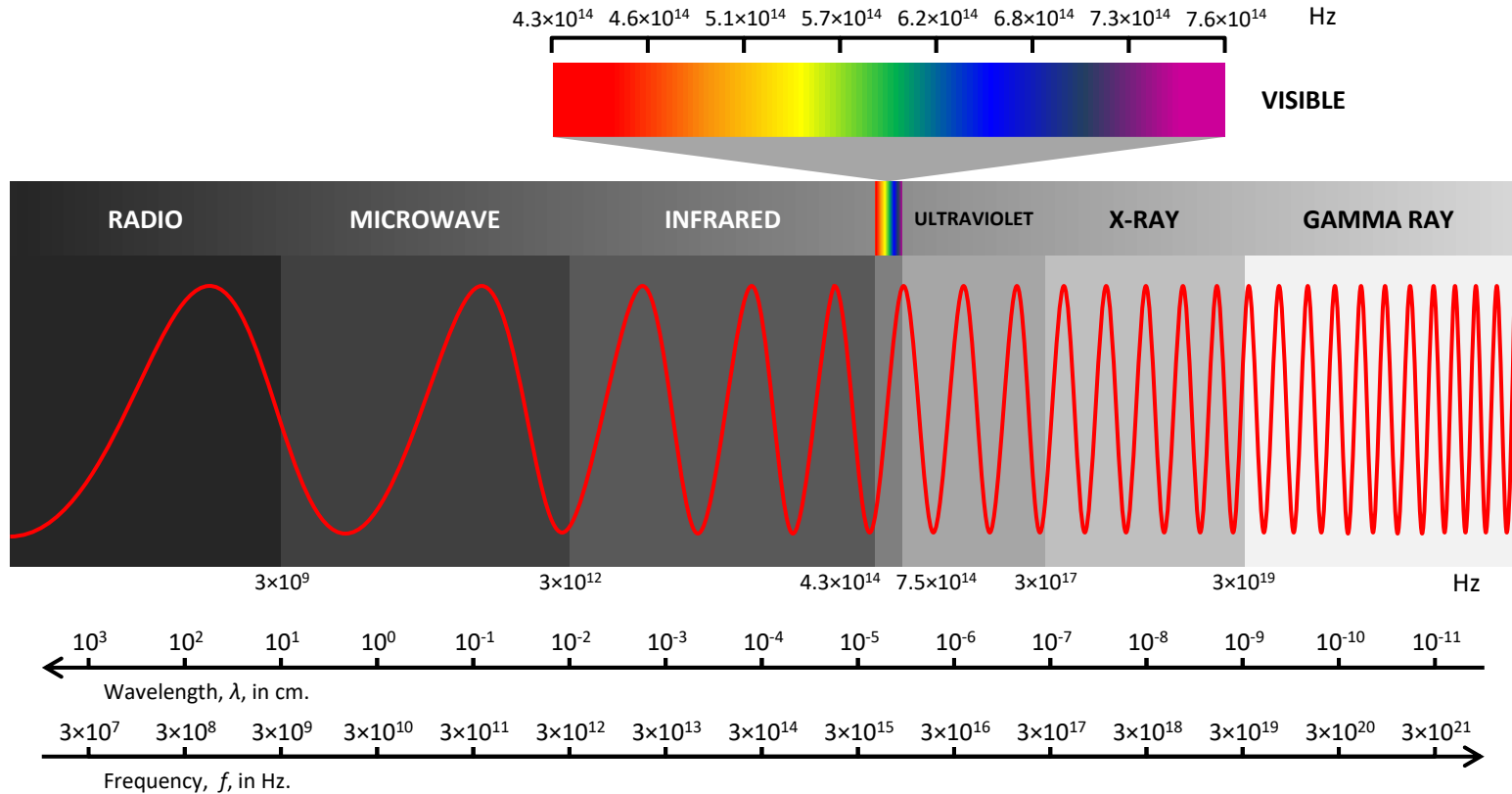


The space program

- NSSDC Image Catalog – Ranger 7
 - https://nssdc.gsfc.nasa.gov/imgcat/html/mission_page/EM_Ranger_7_page1.html



The electromagnetic spectrum



The electromagnetic spectrum

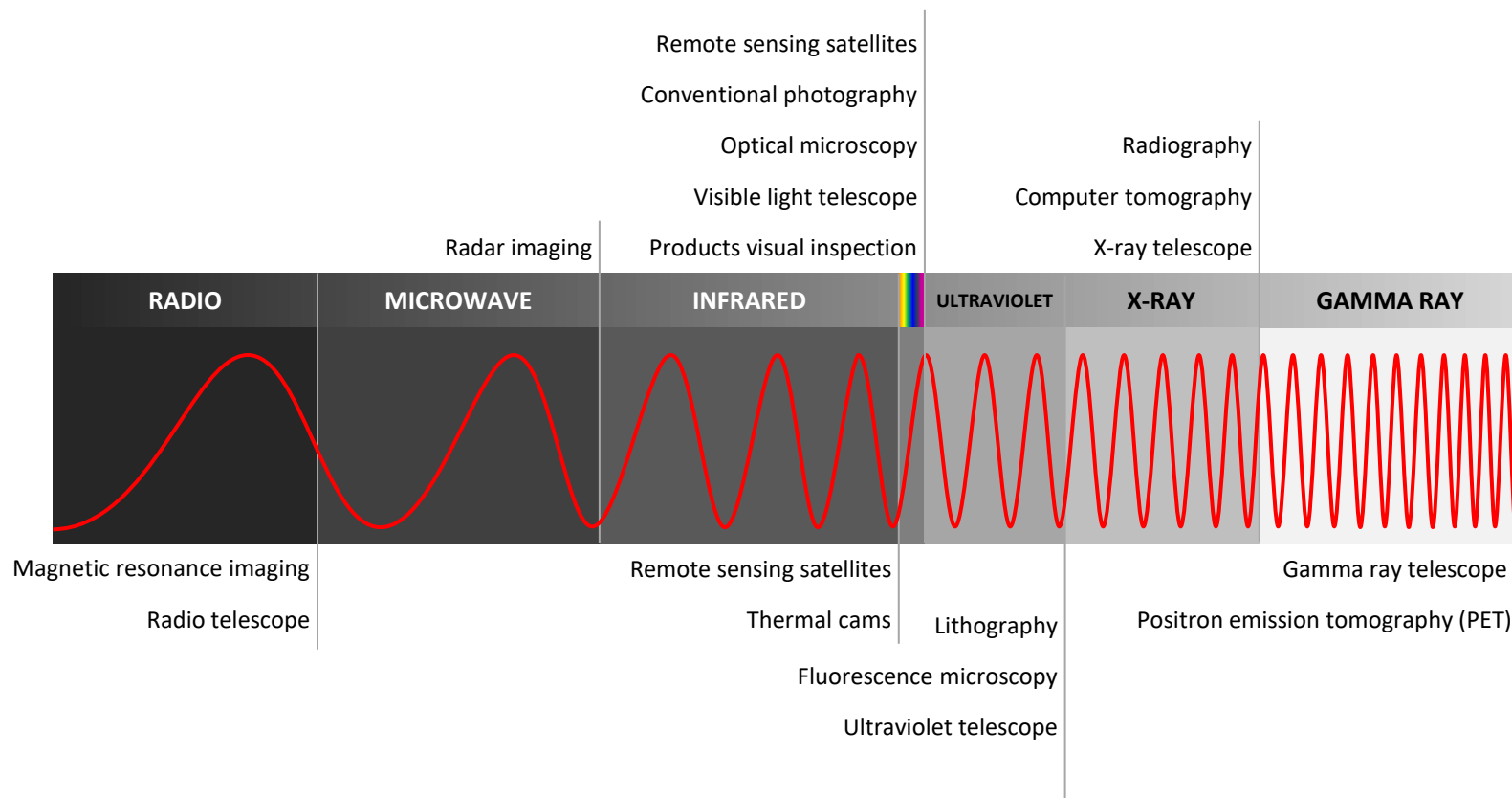
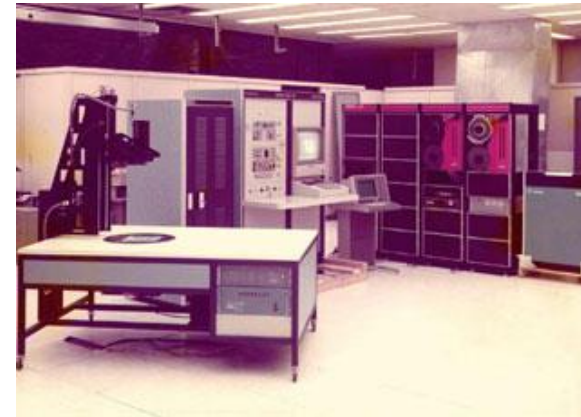


Image processing in Brazil

- INPE – National Institute for Space Research
 - (INPE – Instituto Nacional de Pesquisas Espaciais)
- GE IMAGE-100, 1974
 - Image Processing System
 - US\$ 1.000.000,00
 - PDP/11-45 with 128 KB memory
 - Video memory of 512 x 512 pixels



INPE. <http://www.inpe.br/noticias/galeria/>



INPE: <http://www.dpi.inpe.br/DPI/institucional/pessoal/historico>

Image processing in Brazil

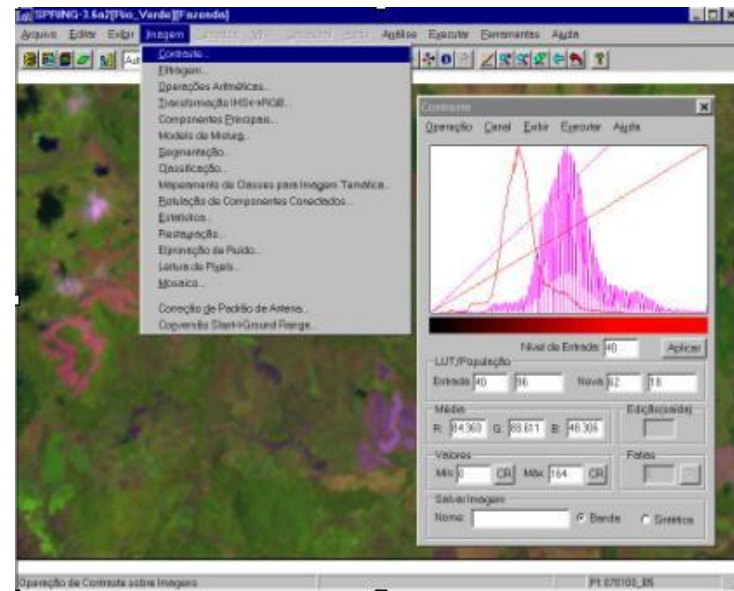
- INPE – National Institute for Space Research
- SITIM – Sistema de Tratamento de Imagens, 1986
 - (in English, Image Treatment System).
 - PC-286 with 8 MHz and 256 Kb memory
 - Graphic card locally developed
 - Images with until 1024 x 1024 pixels and 24 bits per pixel
 - MS-DOS



INPE: <http://www.dpi.inpe.br/DPI/institucional/pessoal/historico>

Image processing in Brazil

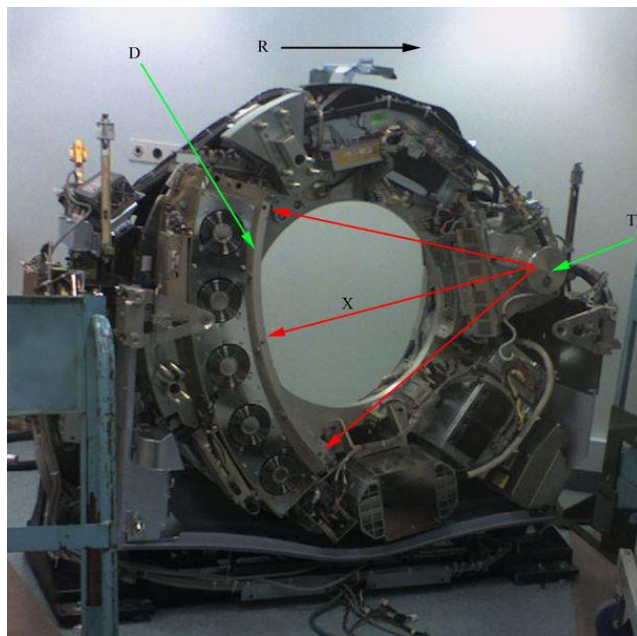
- INPE – National Institute for Space Research
- SPRING – Sistema Integrado de Geoprocessamento e Processamento de Imagens, 1991
 - (in English, Integrated Geoprocessing and Image Processing System)
 - Graphical user interface
 - Currently available for download
 - <http://www.dpi.inpe.br/spring/>



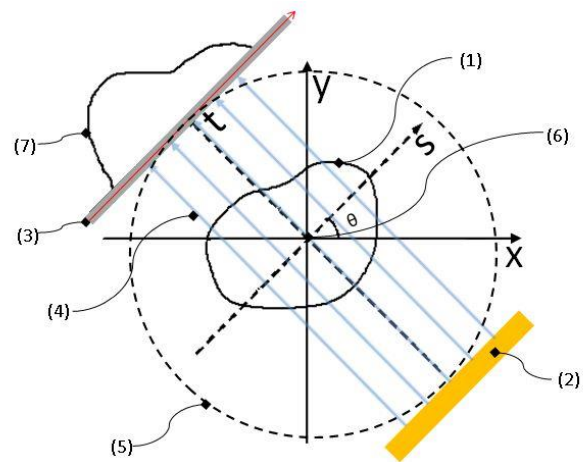
INPE: <http://www.dpi.inpe.br/DPI/institucional/pessoal/historico>

An image processing application

- Computer tomography
 - Allan Cormack and Newbold Hounsfield (1972)

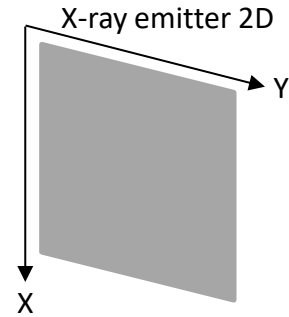
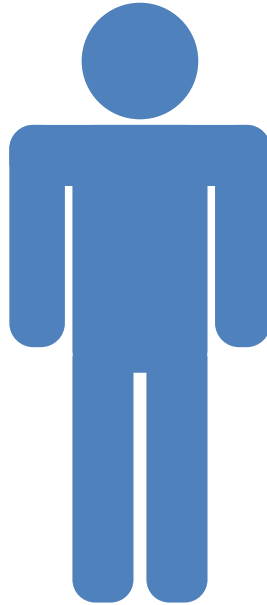


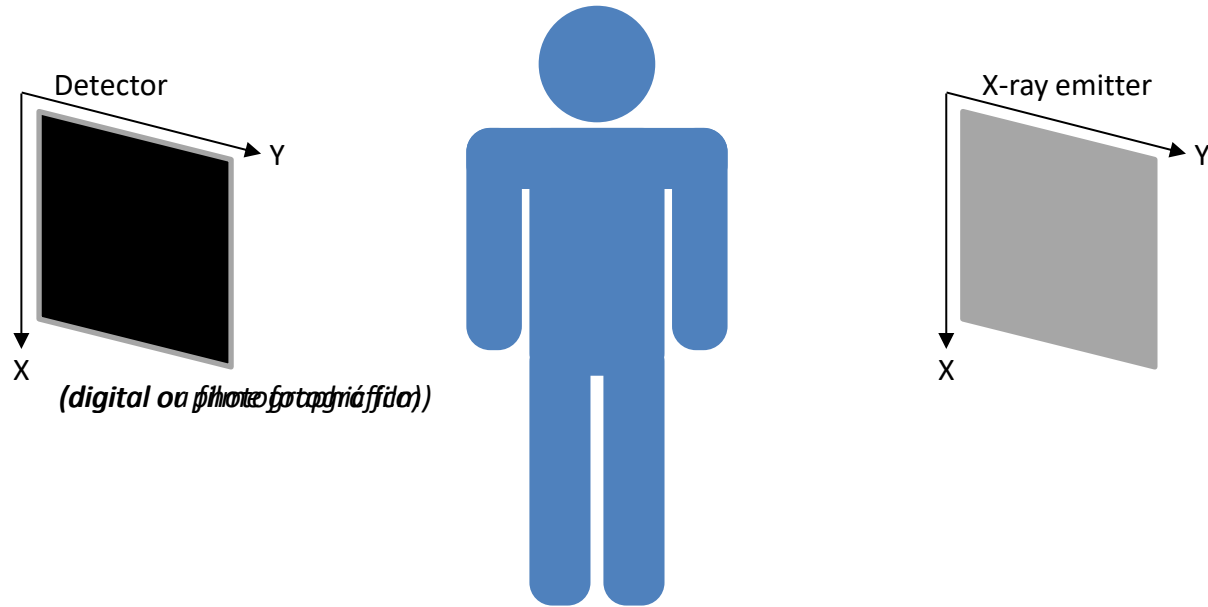
https://pt.wikipedia.org/wiki/Tomografia_computadorizada

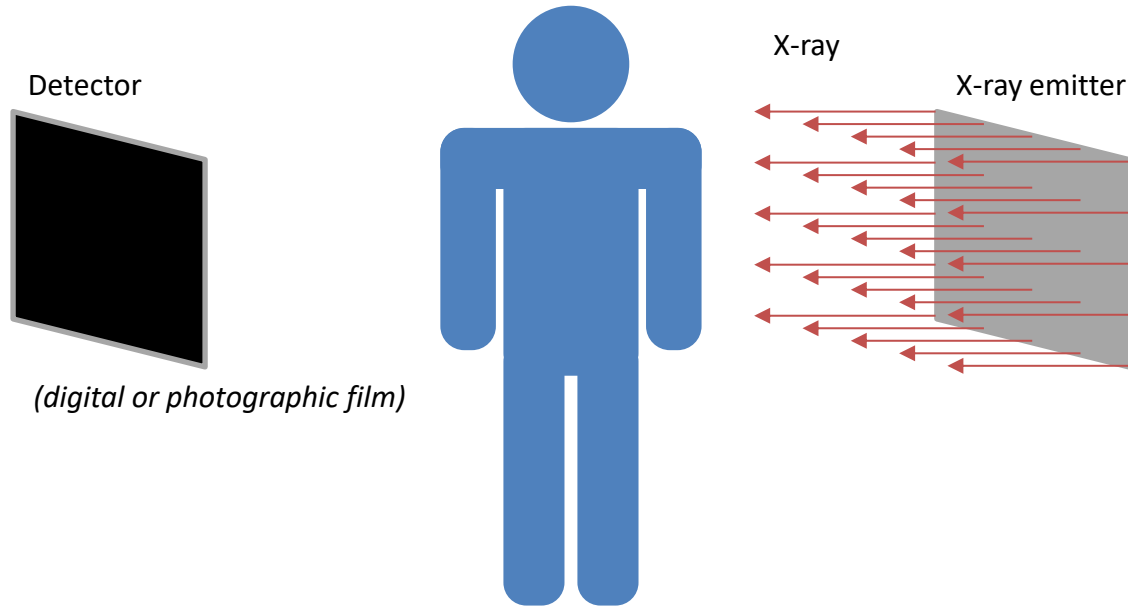


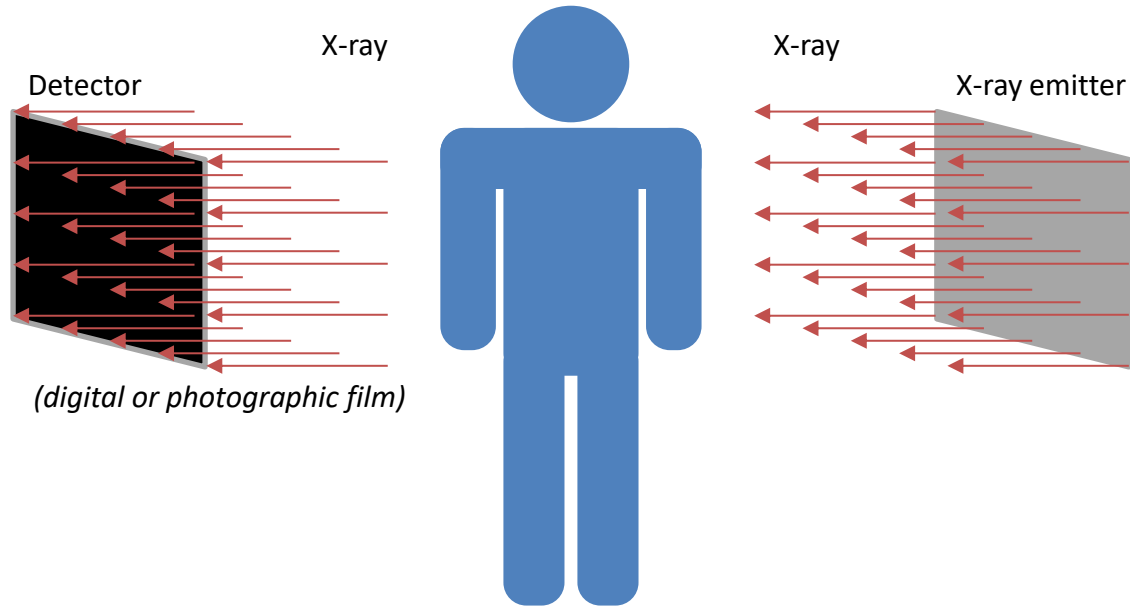
https://pt.wikipedia.org/wiki/Transformada_de_Radon

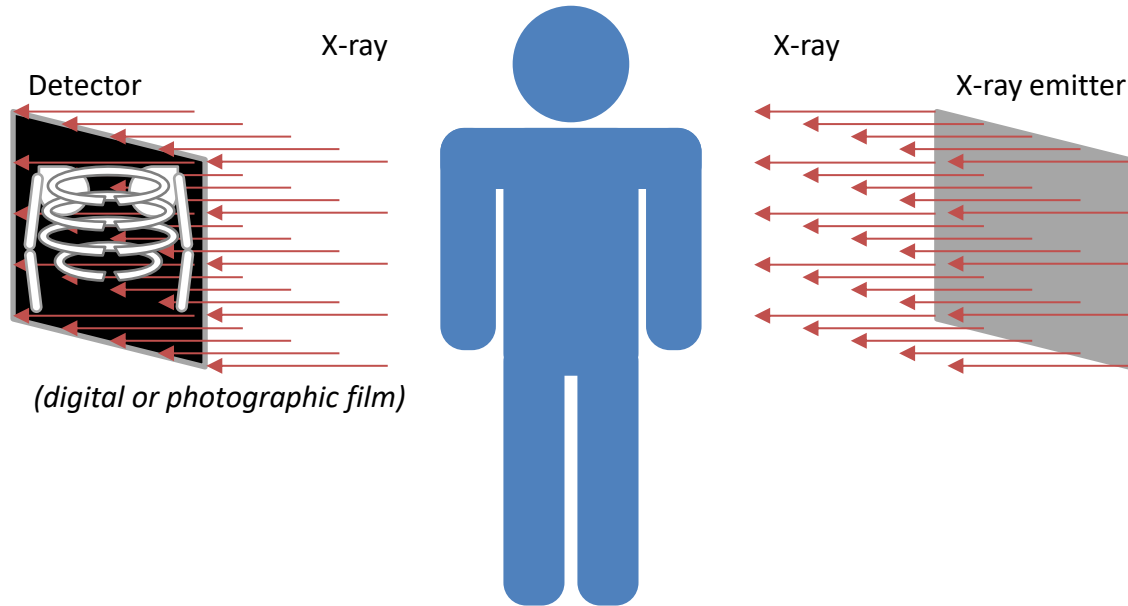
1. Objeto radiografado;
2. Emissor de raios X;
3. Sensor;
4. Feixe de raios que atravessa o objeto, sofrendo uma atenuação;
5. Limites do aparelho;
6. Origem dos sistemas de referência;
7. Medida obtida no detector.

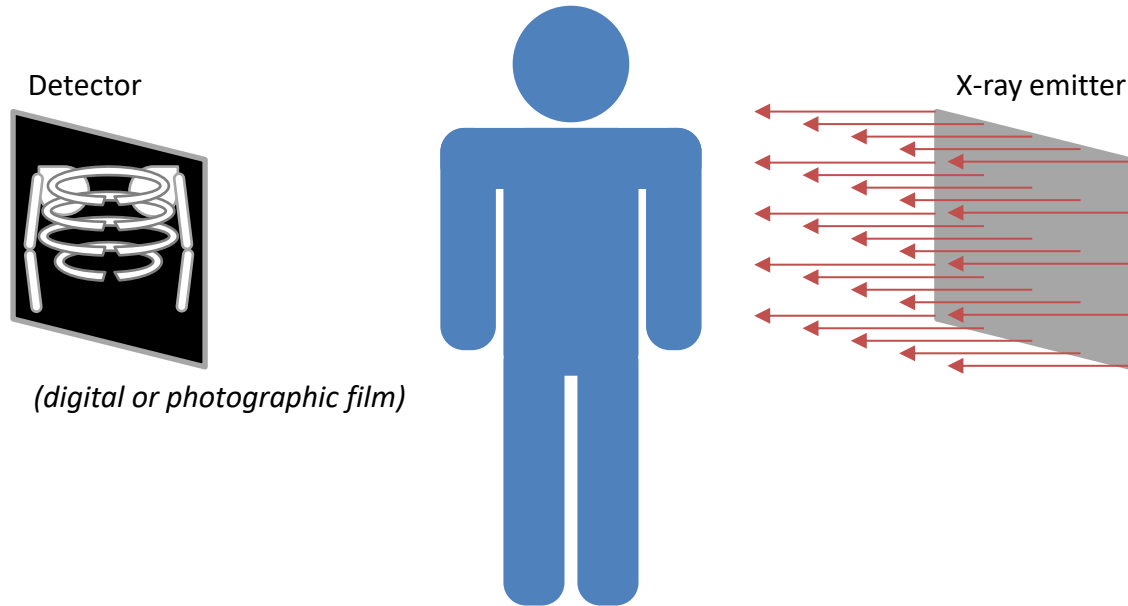






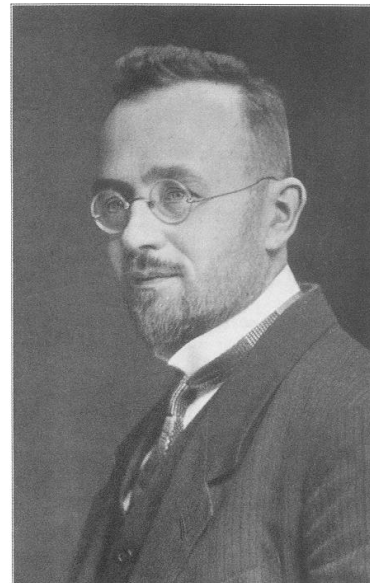
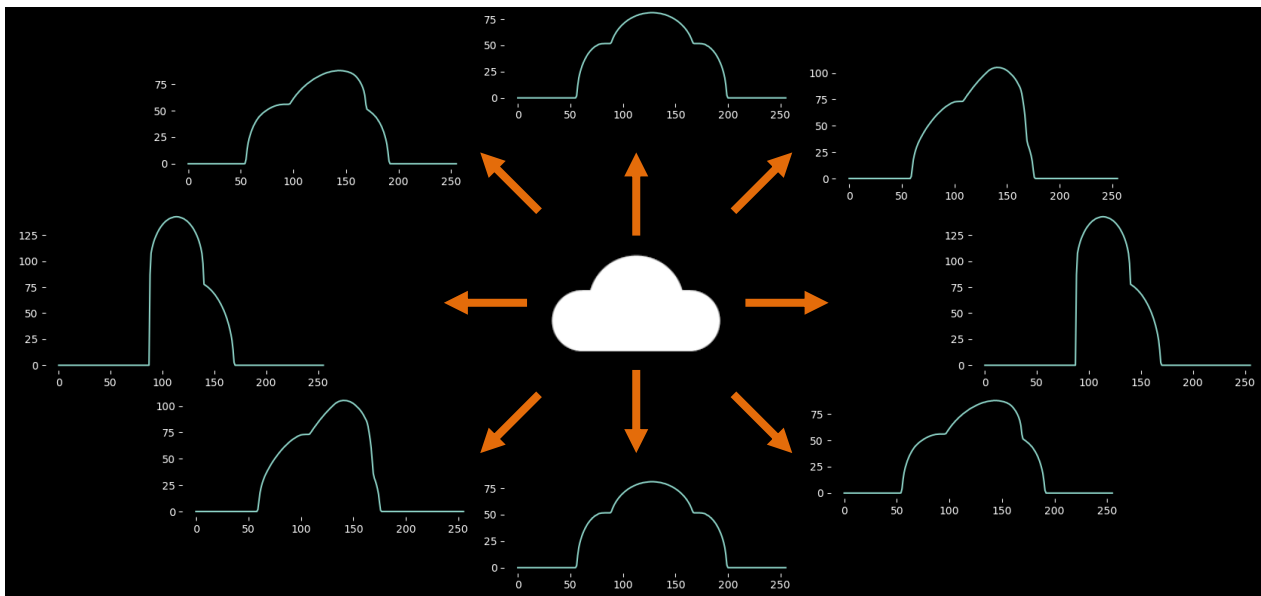
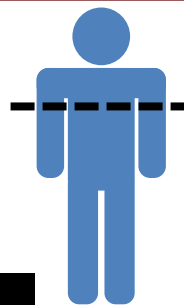






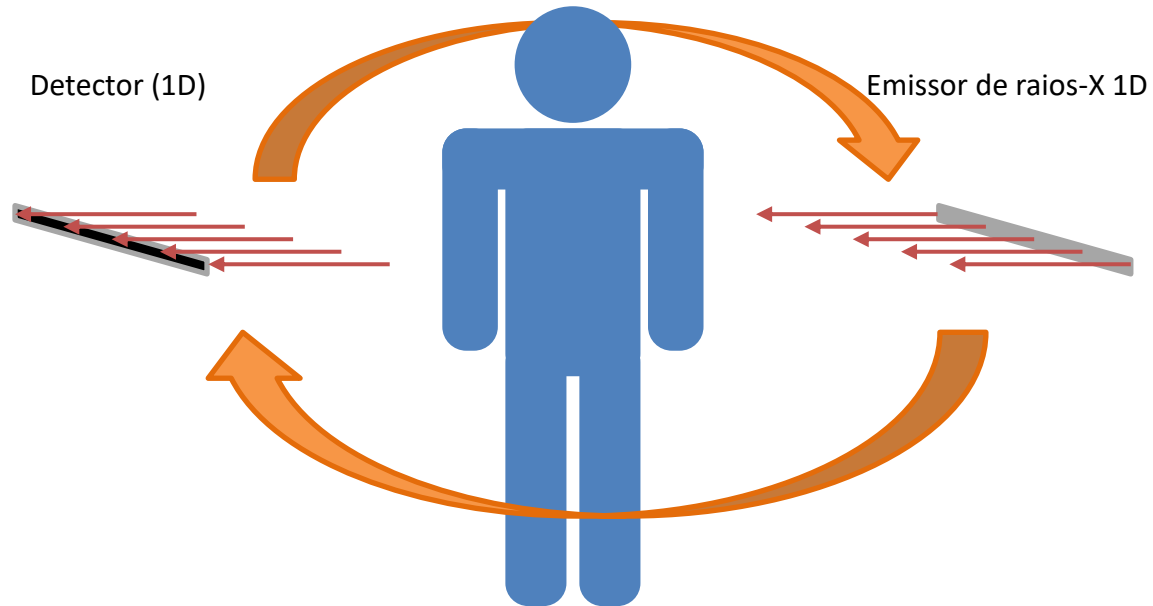
Computer tomography

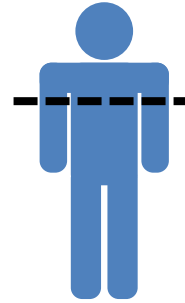
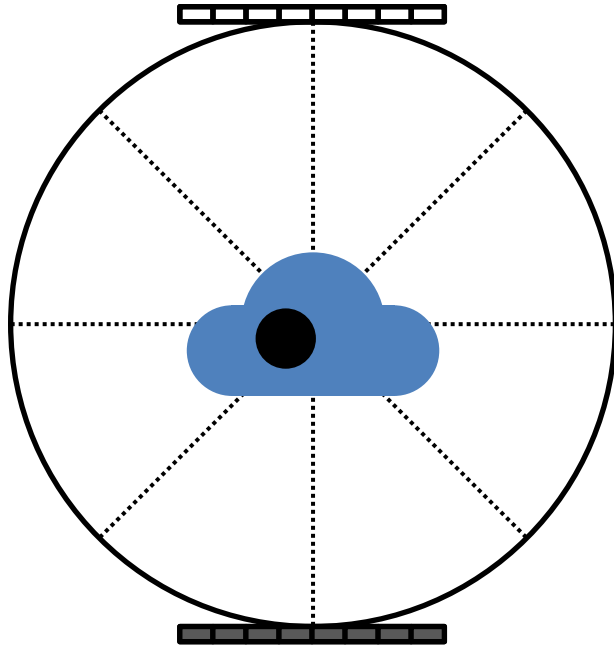
- The Radon transform
 - Johann Radon (1917)
 - Reconstrução de funções a partir de projeções

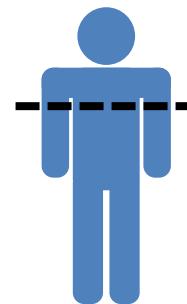
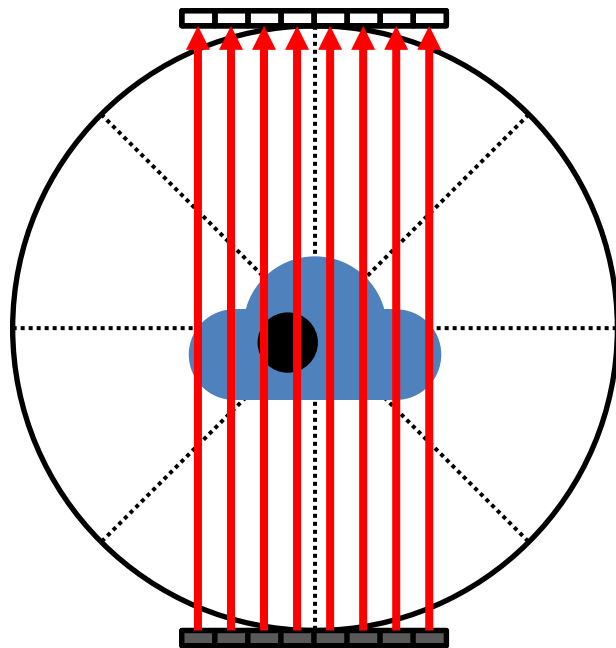


J. Radon

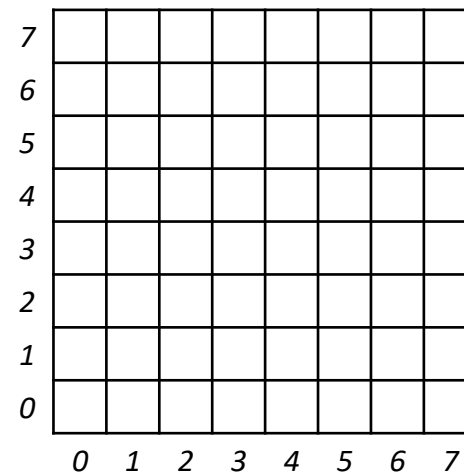
https://pt.wikipedia.org/wiki/Johann_Radon

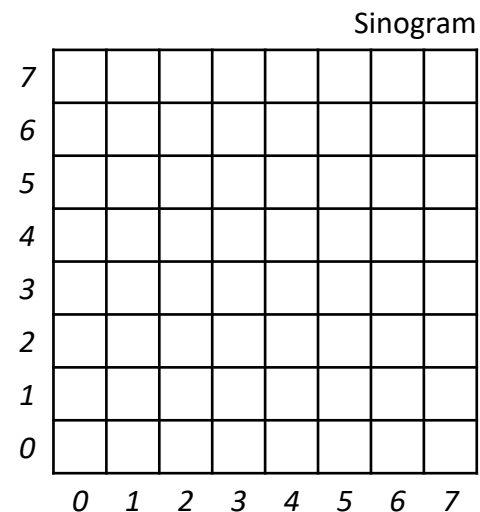
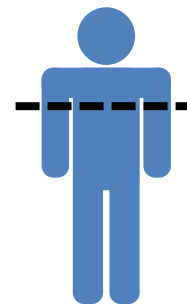
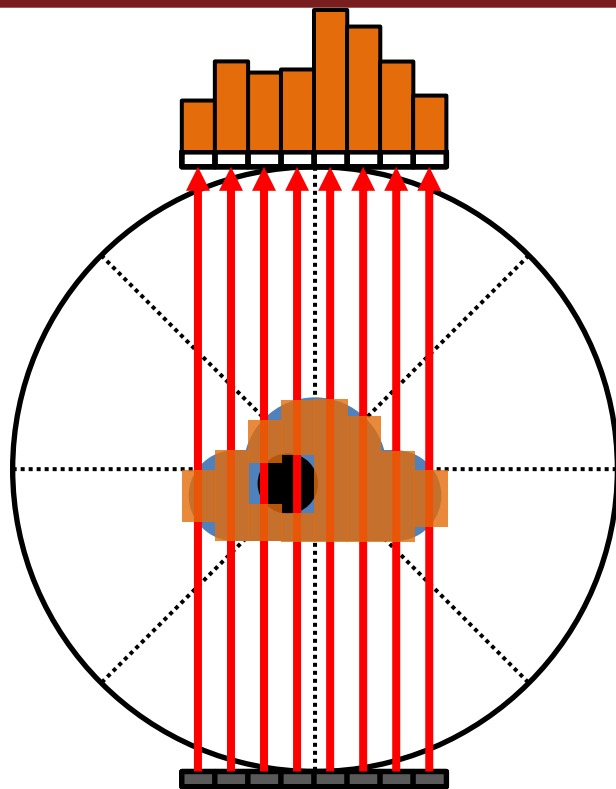


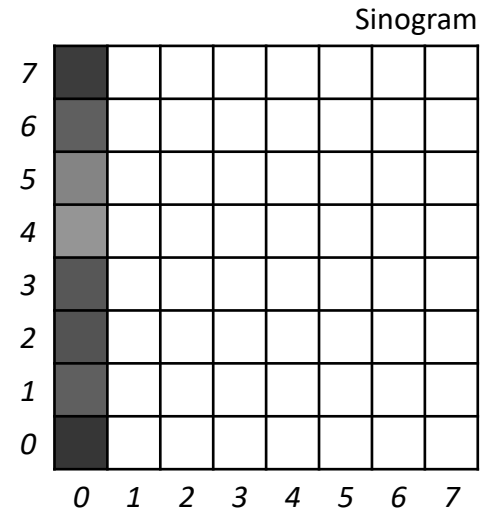
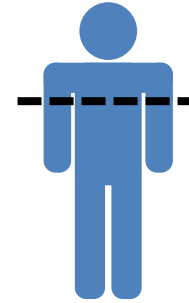
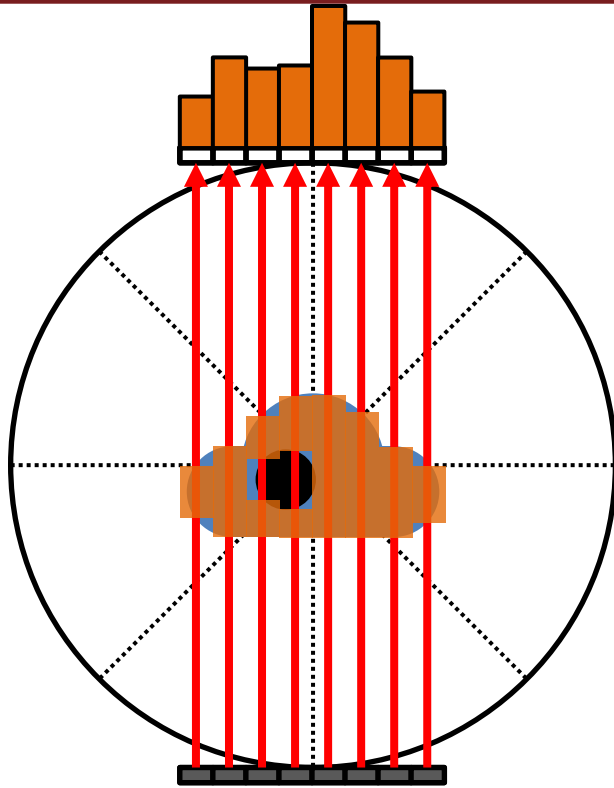


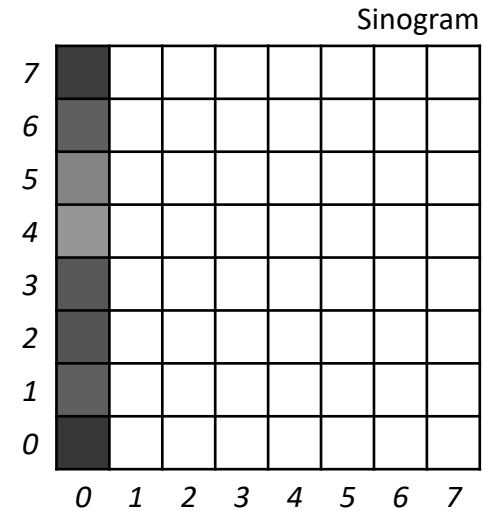
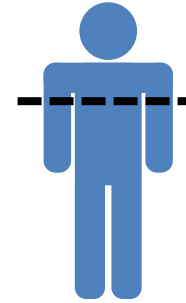
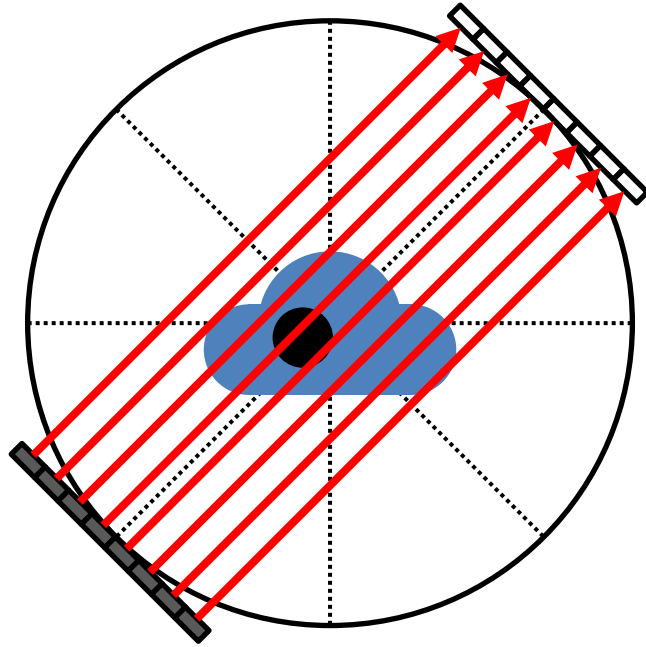


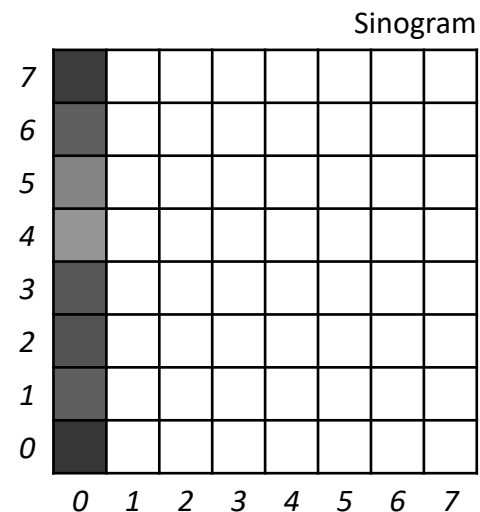
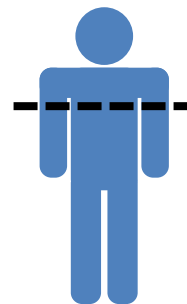
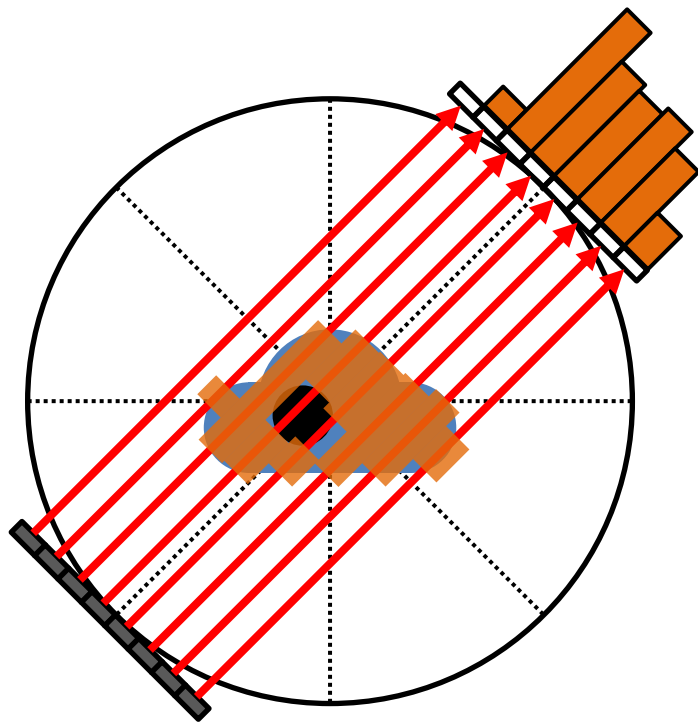
Sinograma

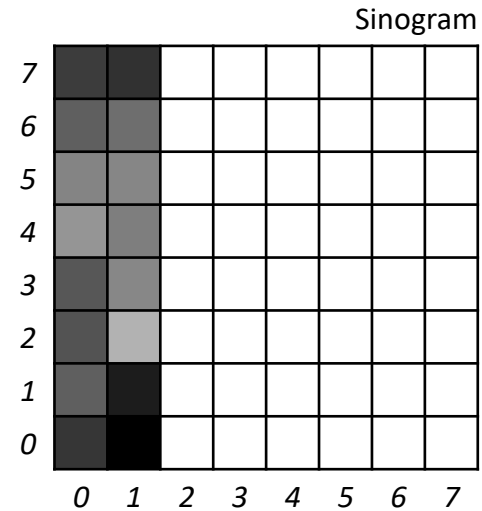
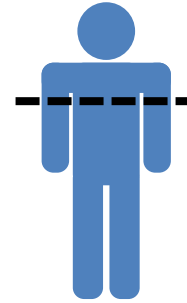
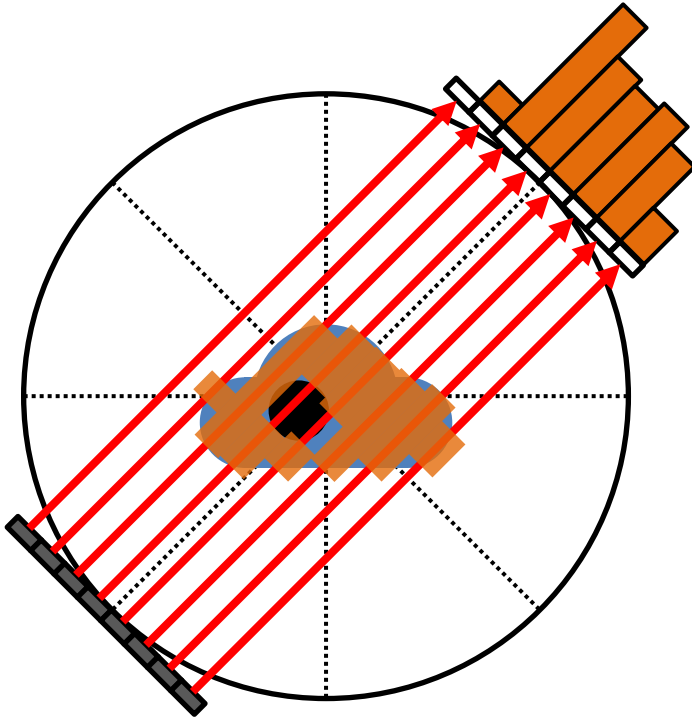


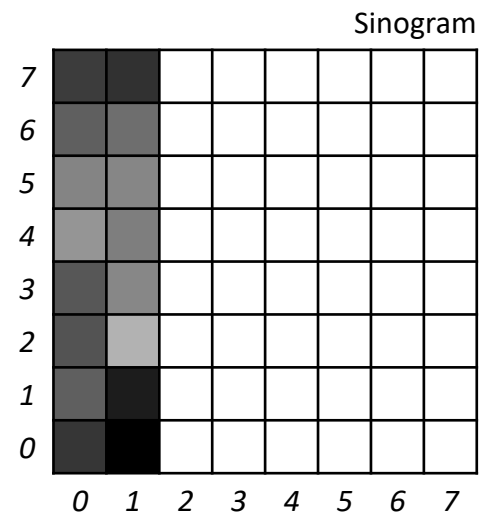
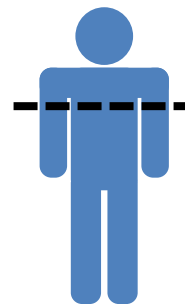
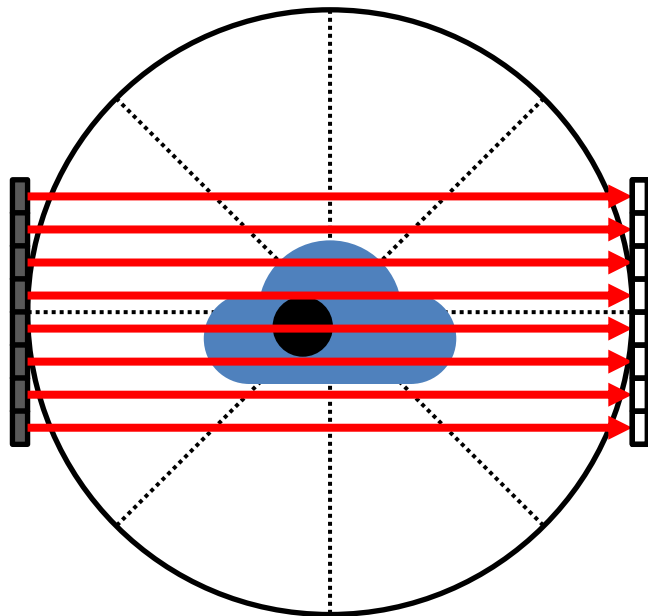


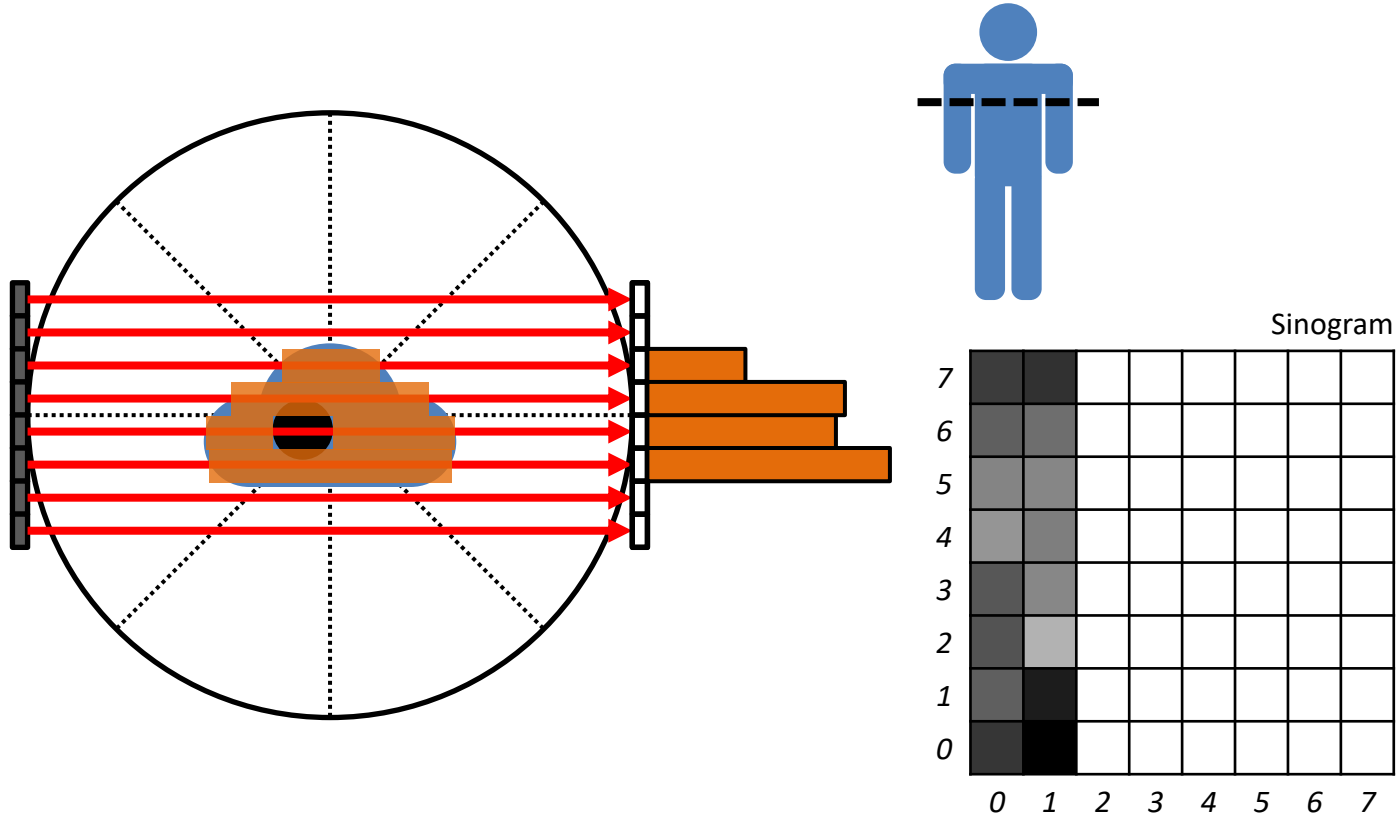


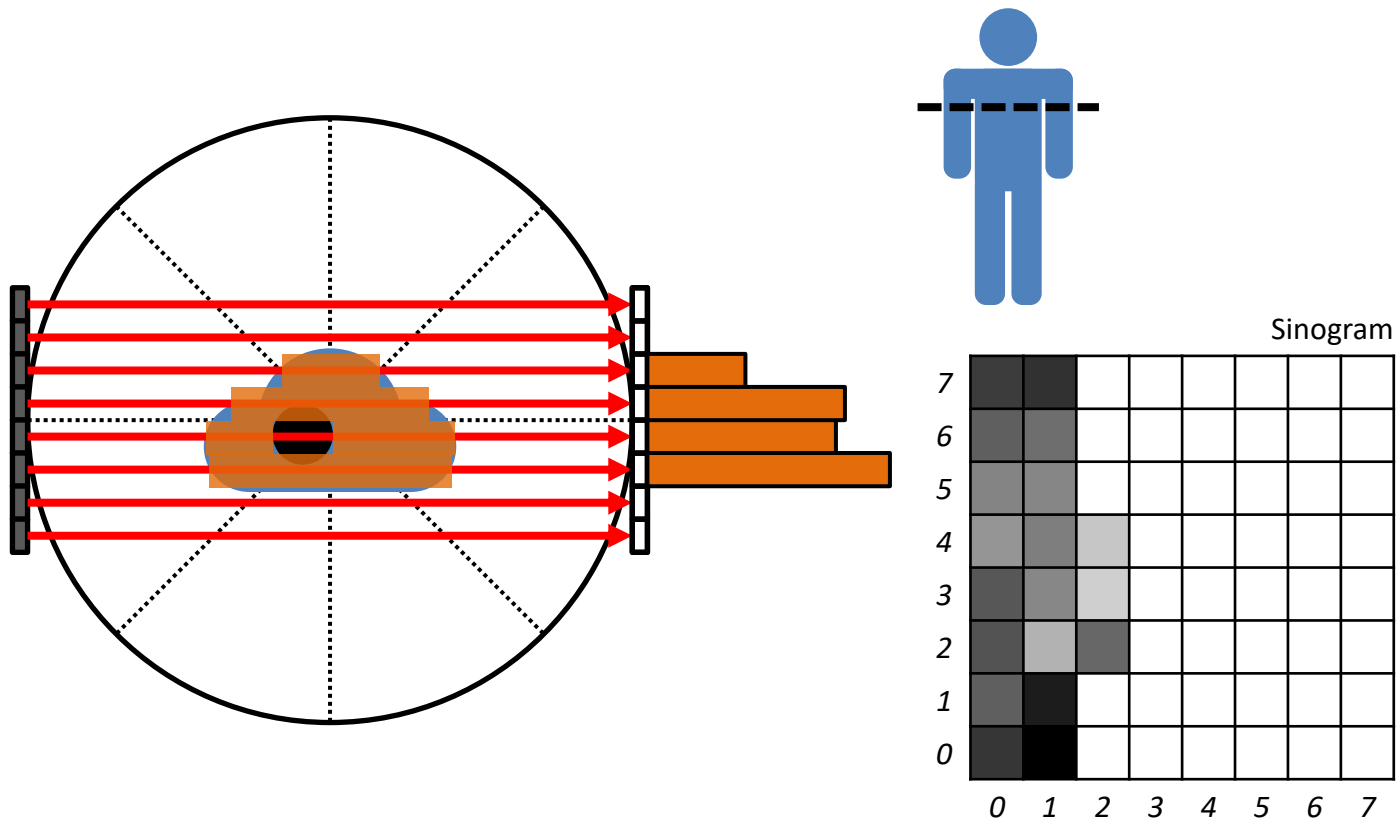


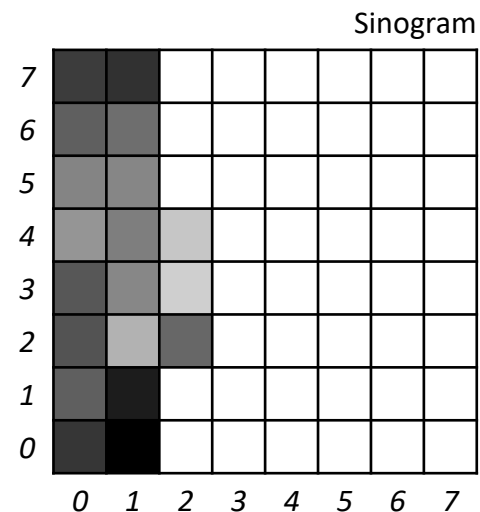
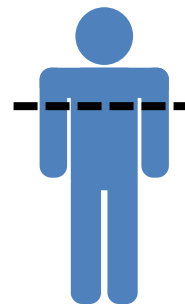
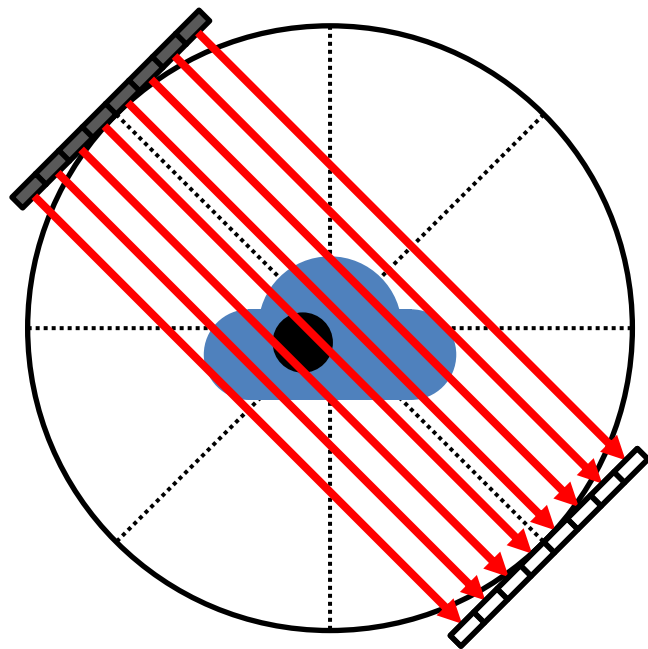


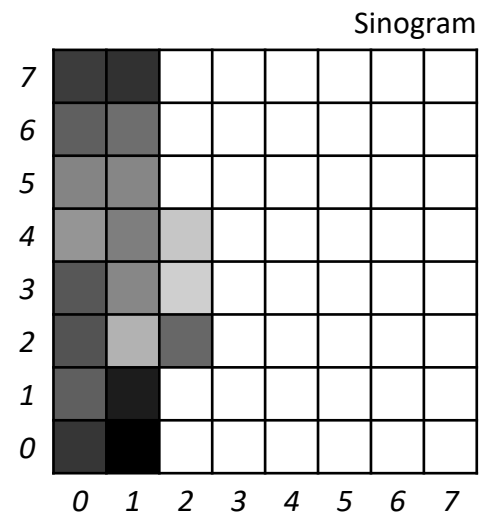
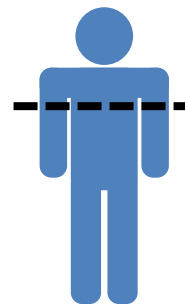
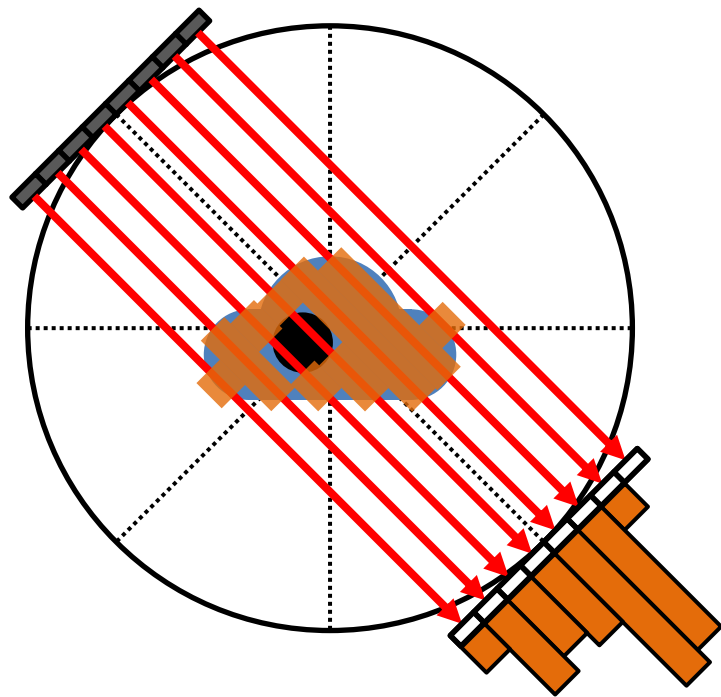


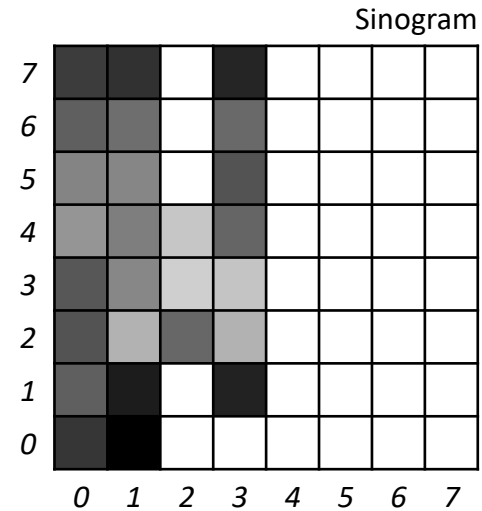
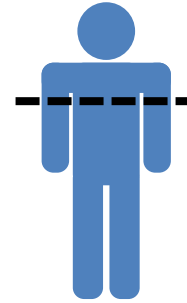
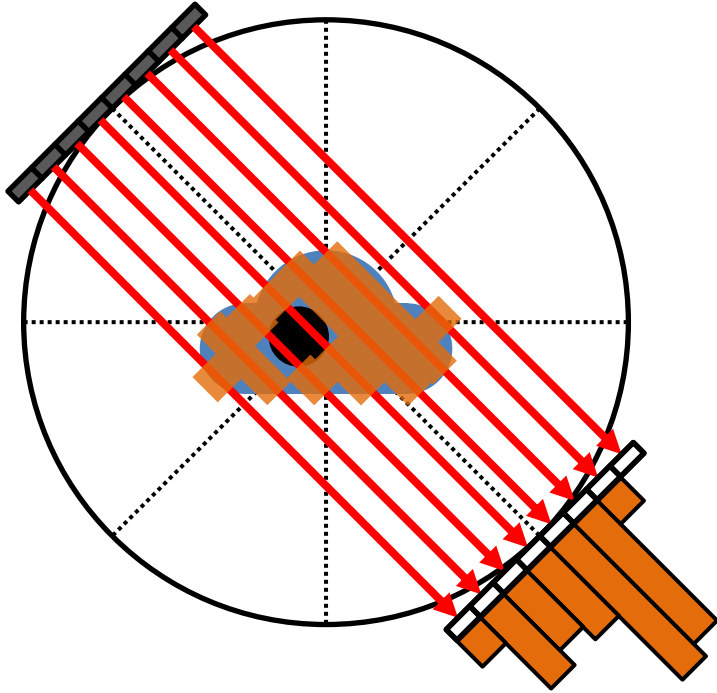


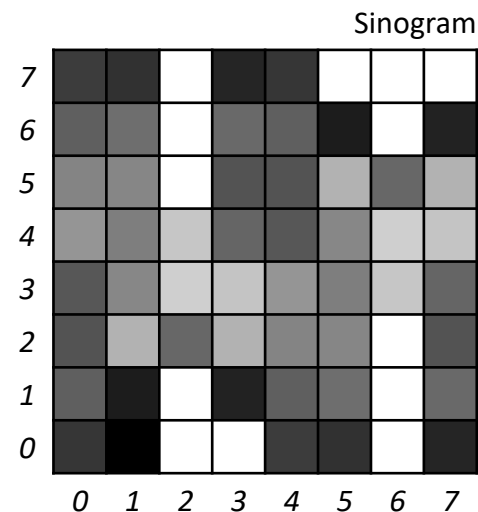
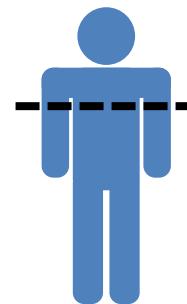
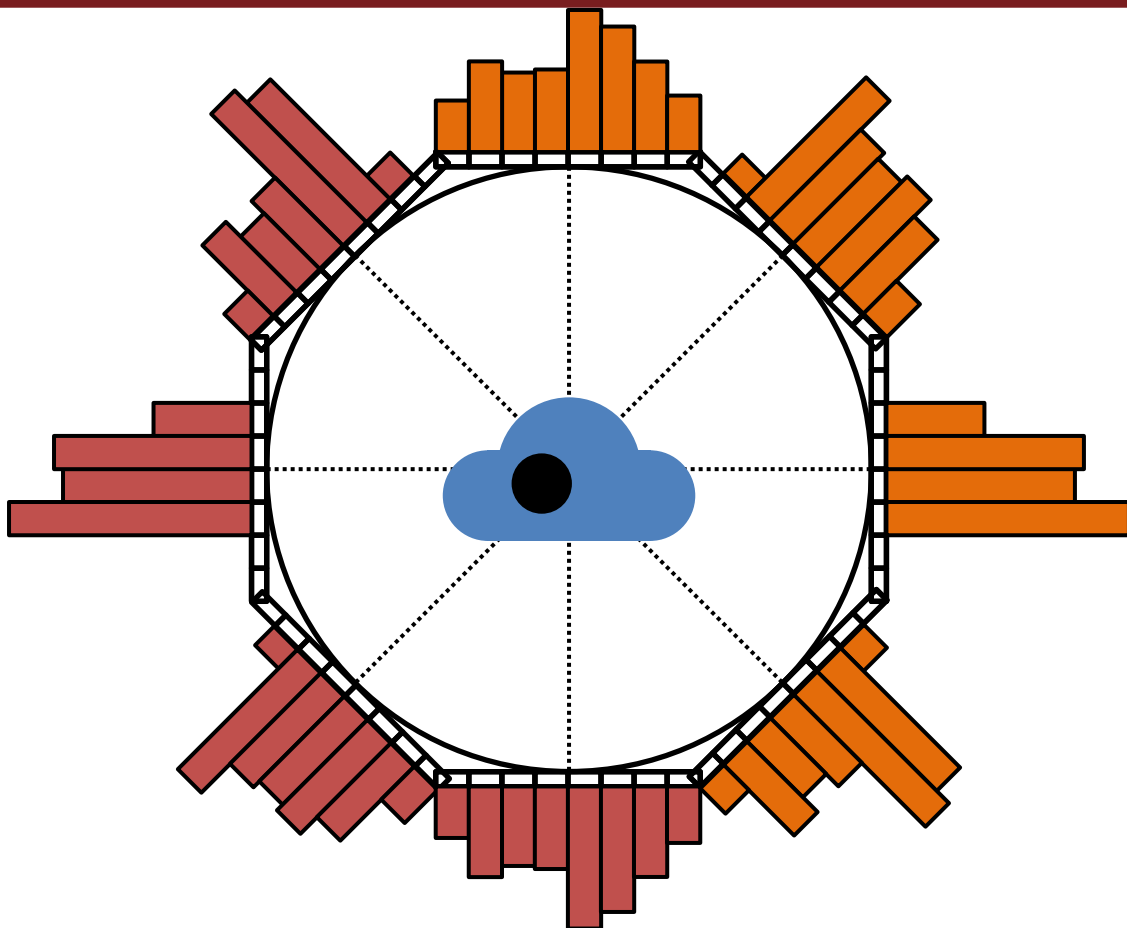












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 - <https://airandspace.si.edu/stories/editorial/uncovering-secrets-ranger-7>
- US: Ranger 7 - 1964
 - <https://www.youtube.com/watch?v=QGJbybcXd0c>

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