

Aula 01 – Introdução ao processamento de imagens

Prof. João Fernando Mari

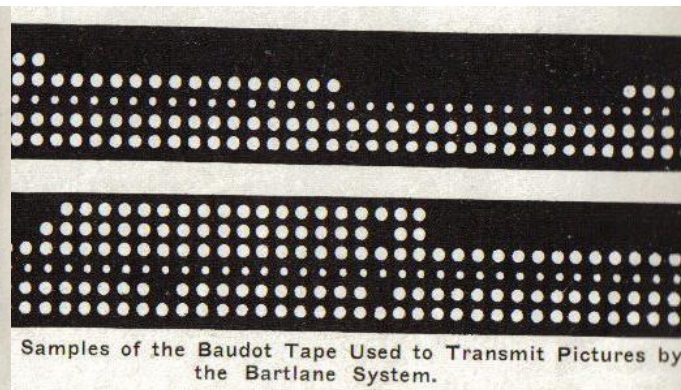
joaofmari.github.io

joaof.mari@ufv.br

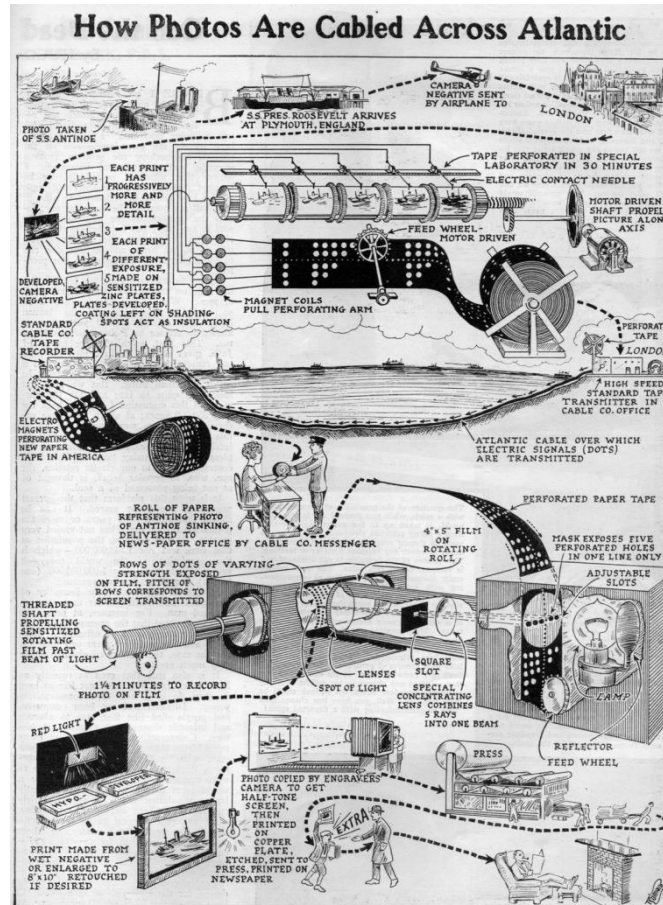
- O sistema Bartlane
- O programa espacial
- O espectro eletromagnético
- Processamento de imagens no Brasil
- Uma aplicação de processamento de imagens
 - Tomografia computadorizada

O sistema Bartlane

- Uma das primeiras aplicações das imagens digitais
- Utilizado para enviar imagens digitais por cabo submarino entre Londres e Nova York.
- Reduziu de mais de uma semana para menos de três horas o tempo necessário para transportar uma fotografia pelo oceano Atlântico.
- Um equipamento codificava as imagens para a transmissão a cabo e depois as reconstruía no recebimento.
- Não ocorria o processamento das imagens

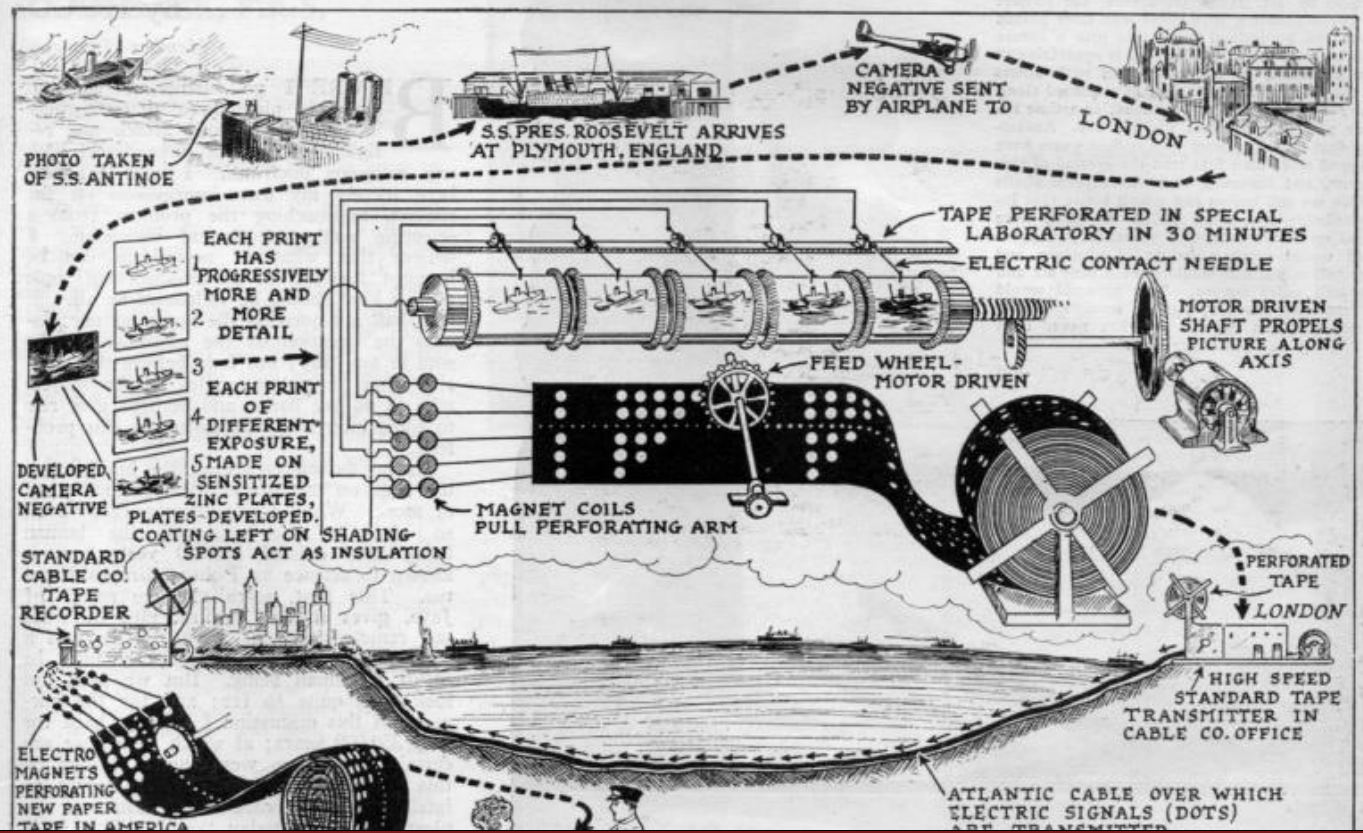
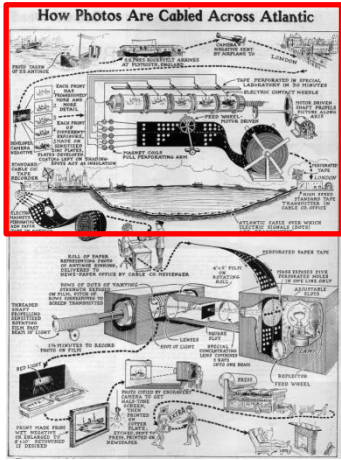


<http://www.hffax.de/history/html/bartlane.html>

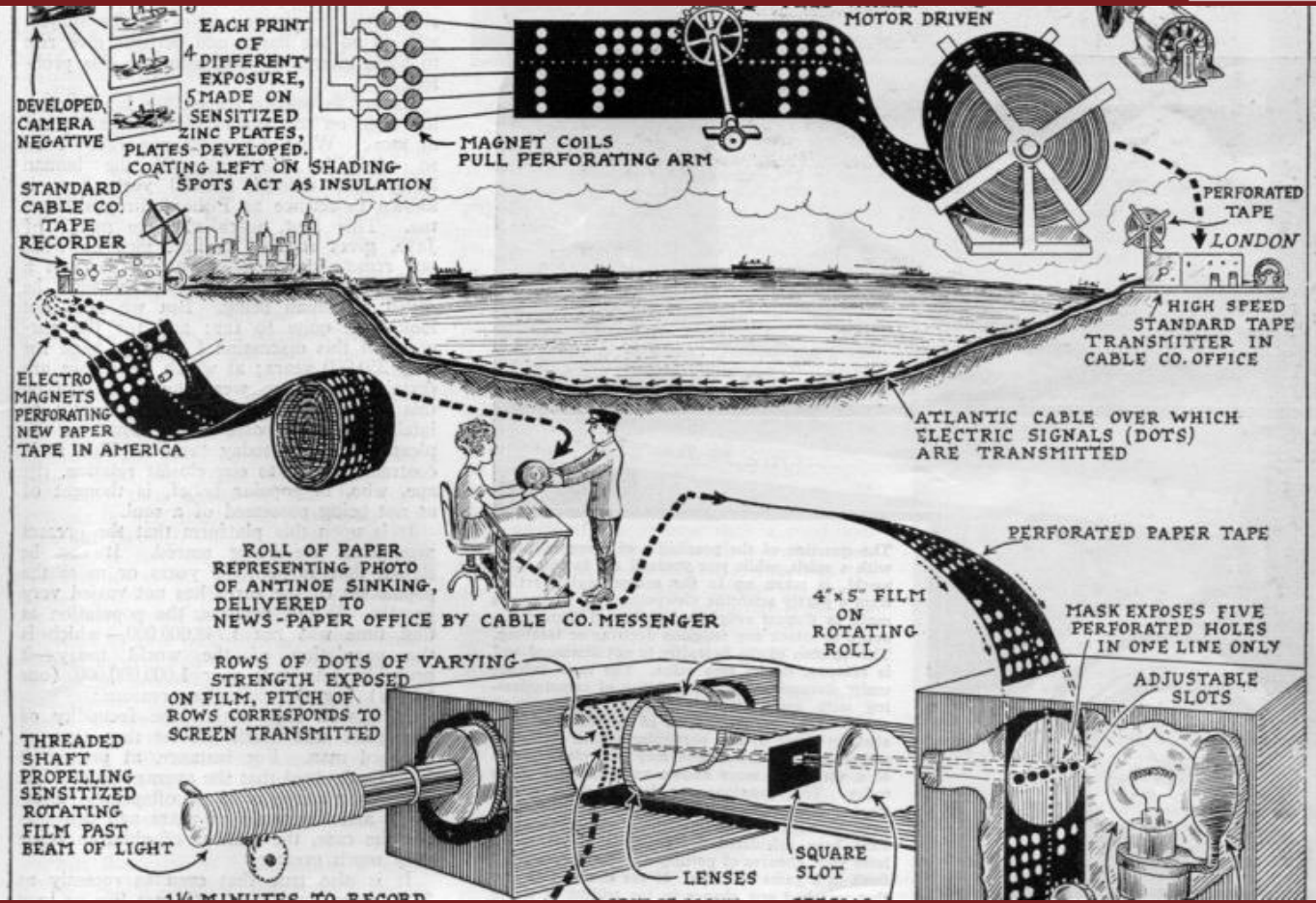
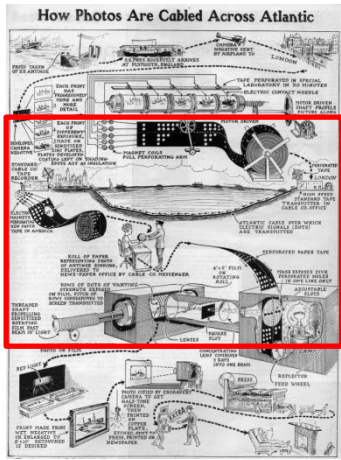


Infográfico publicado originalmente na edição de abril de 1926 da revista *Science and Invention*.

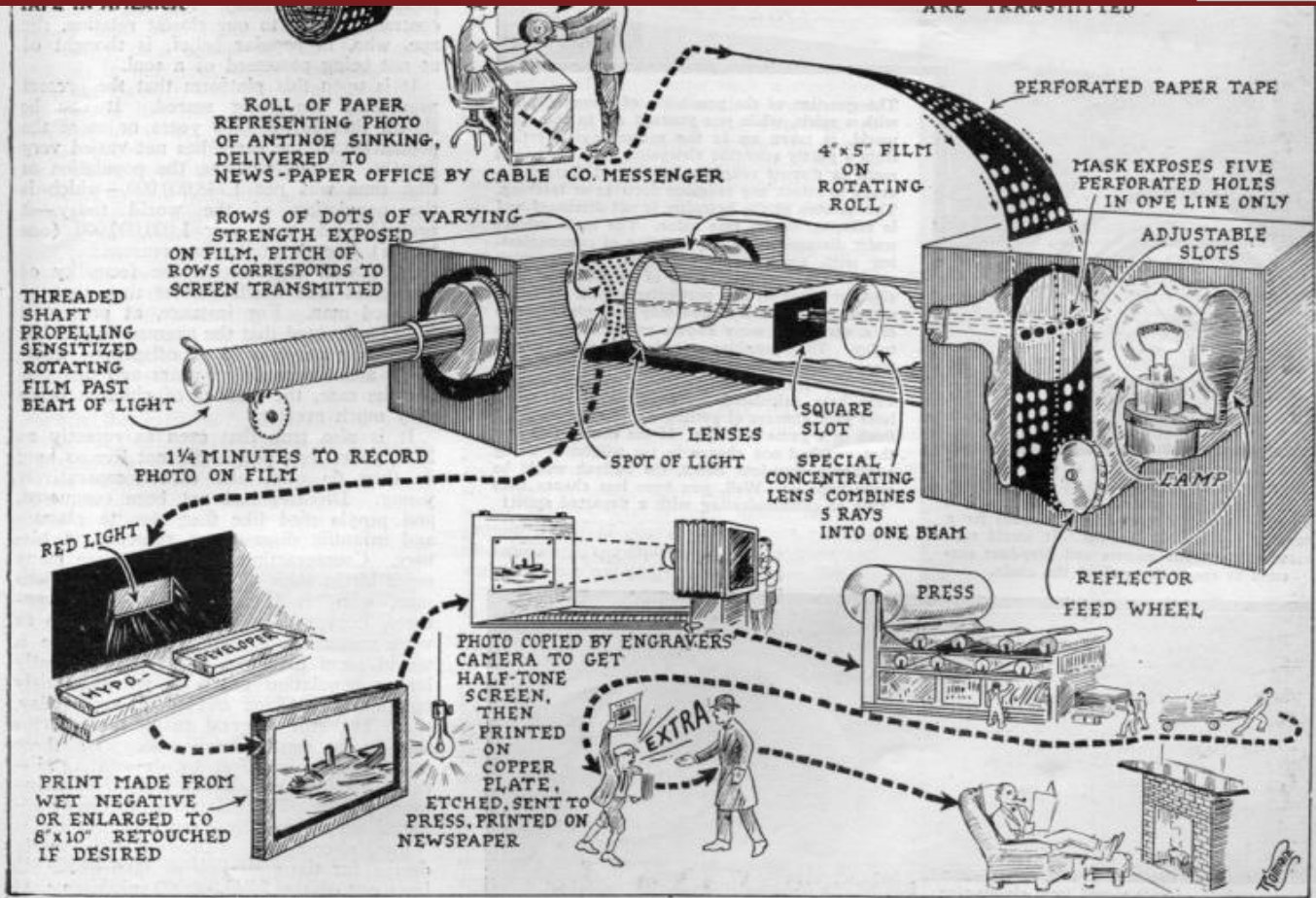
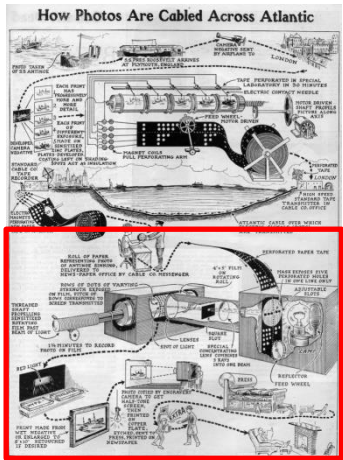
How Photos Are Cabled Across Atlantic



O sistema Bartlane



O sistema Bartlane

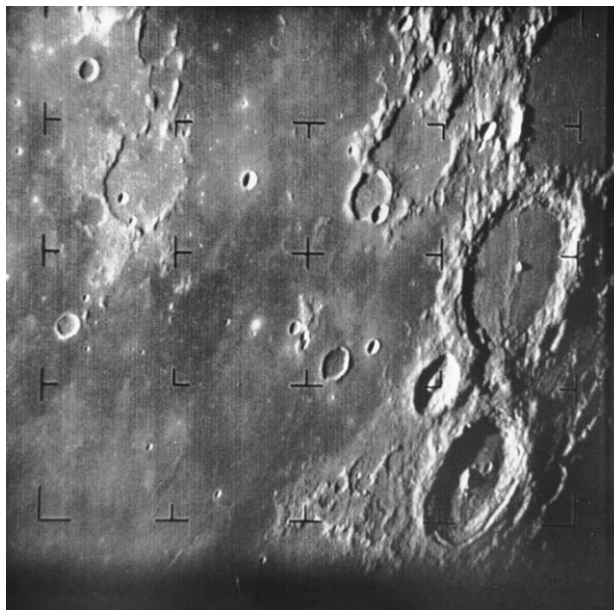


O programa espacial

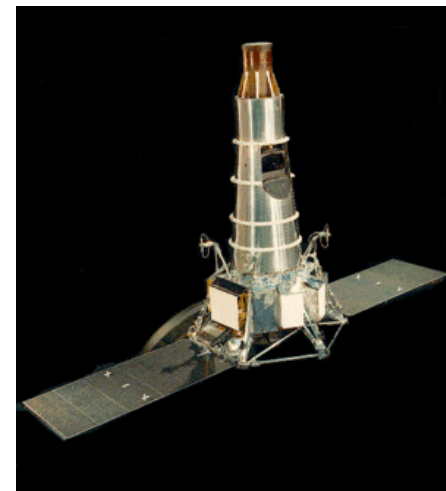
- JPL – Jet Propulsion Lab (Pasadena, Califórnia), 1964
- Ranger 7
 - Sonda espacial Ranger enviada para fotografar a Lua
 - Imagens eram obtidas por câmeras de televisão
 - Enviadas para a Terra por ondas de rádio
 - Necessidade de processar as imagens
 - Melhorar a qualidade das imagens
 - Obter a 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.

O programa espacial

- Primeira imagem da lua tirada pela Ranger 7
- 31 de julho de 1964.
- Cerca de 17 minutos antes do impacto na superfície lunar



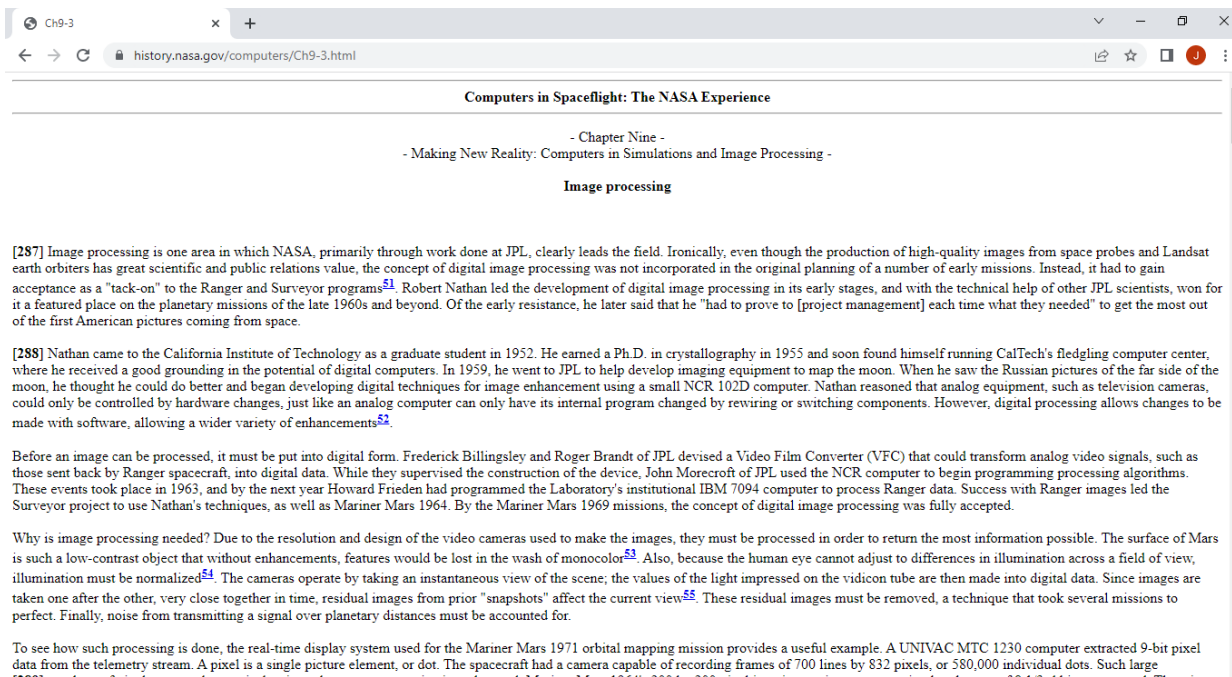
A sonda Ranger 7.



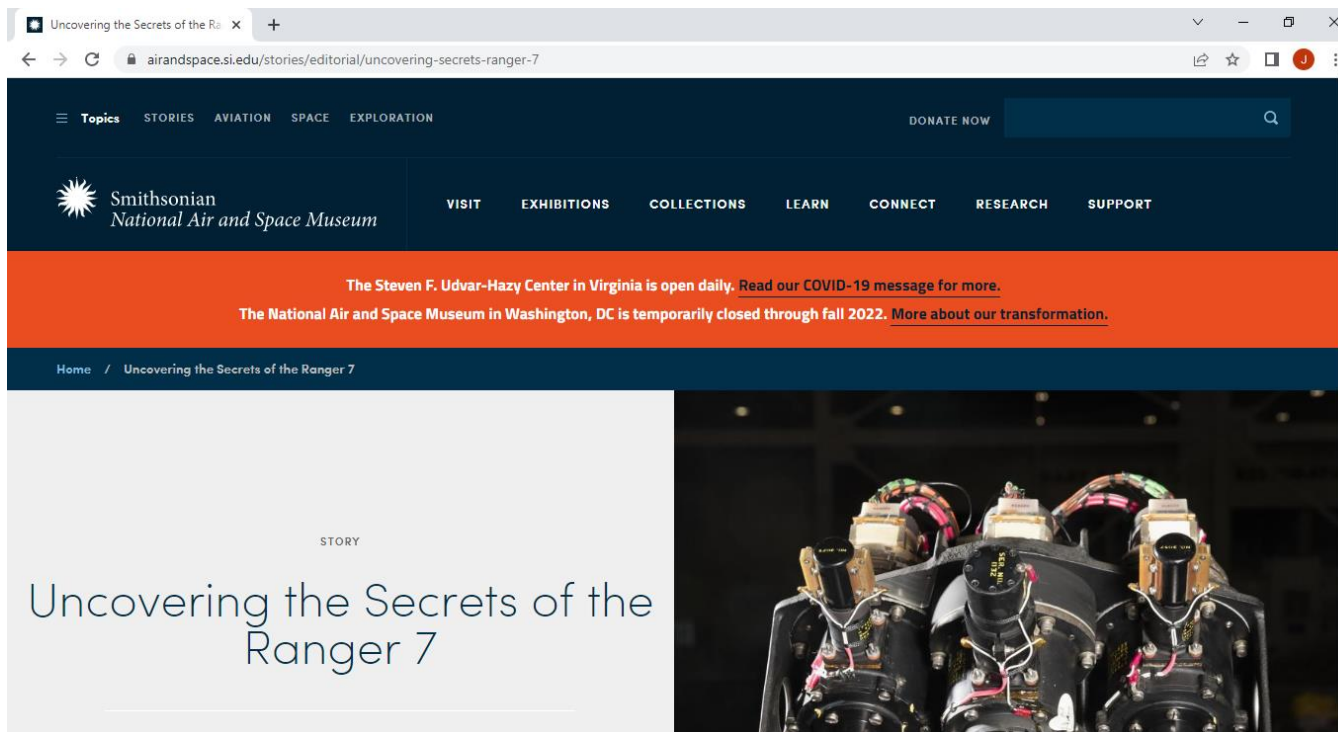
https://pt.wikipedia.org/wiki/Ranger_7

O programa espacial

- 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>



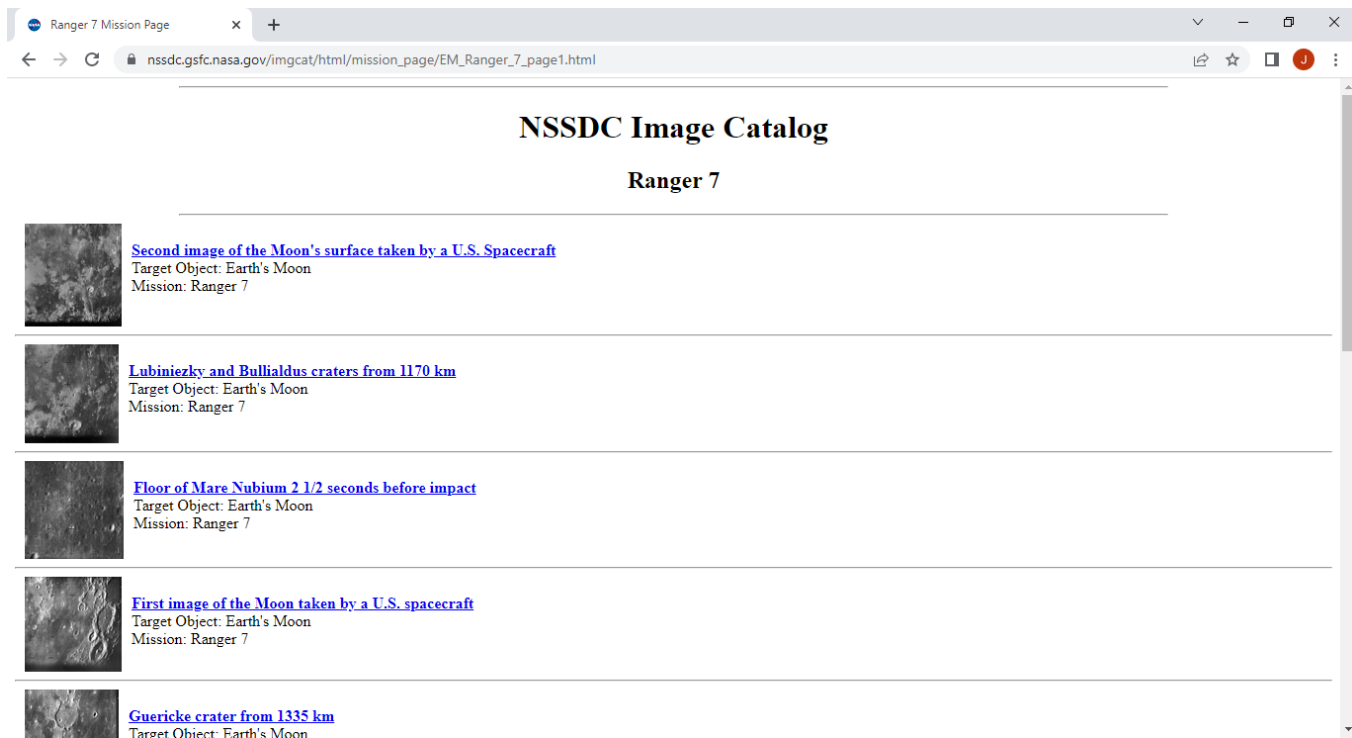
O programa espacial

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

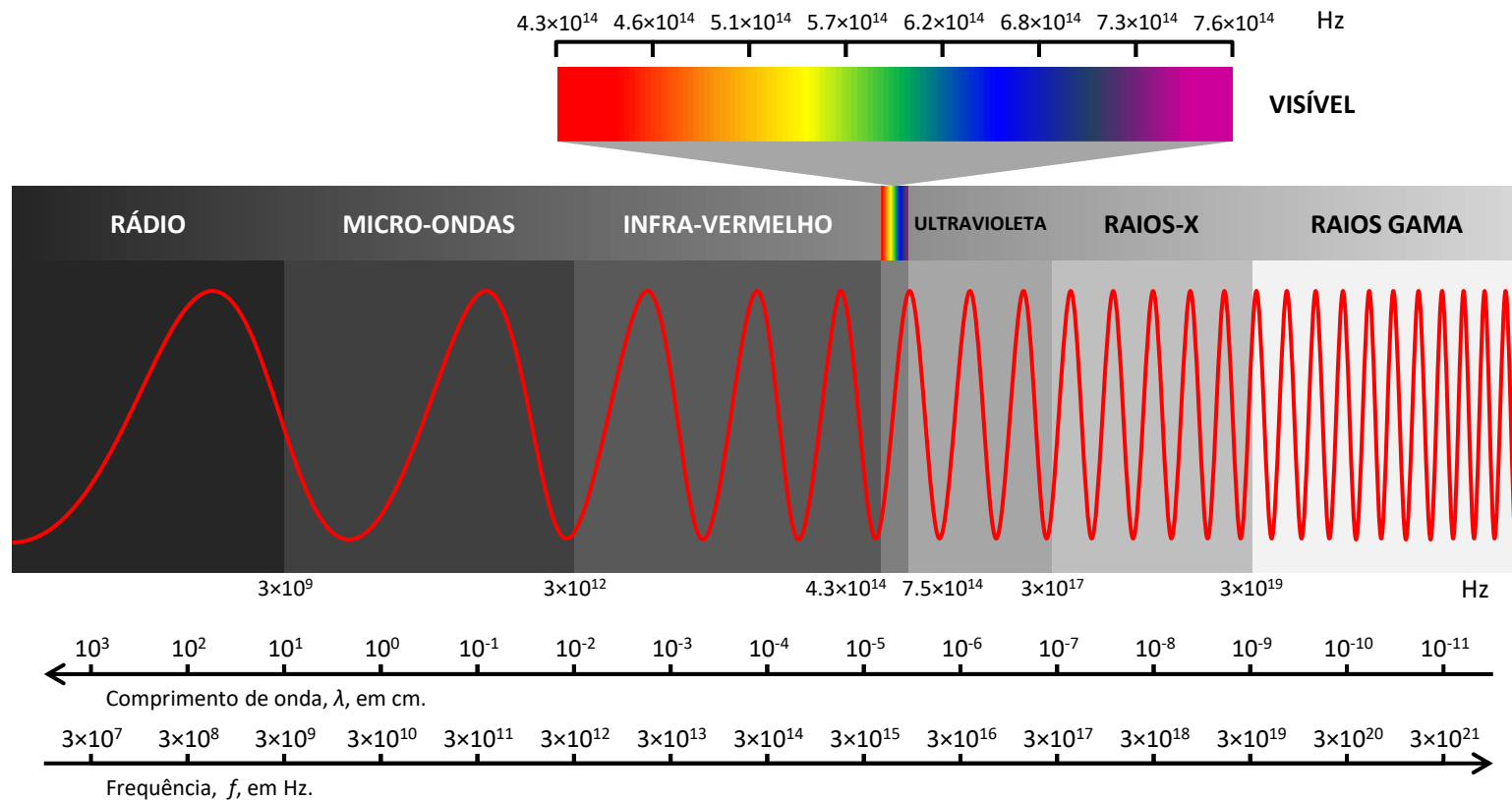


O programa espacial

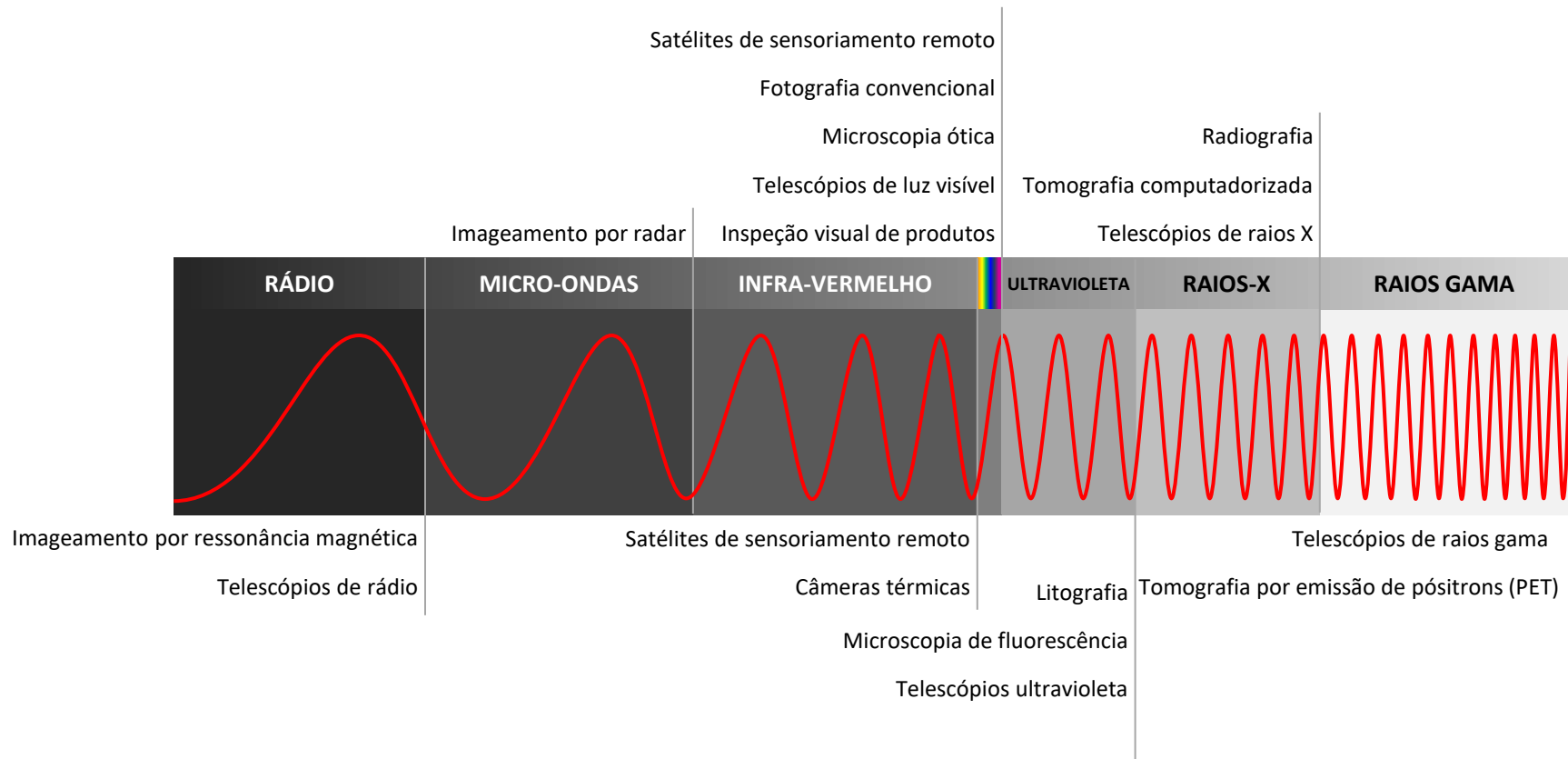
- NSSDC Image Catalog – Ranger 7
 - https://nssdc.gsfc.nasa.gov/imgcat/html/mission_page/EM_Ranger_7_page1.html



O espectro eletromagnético



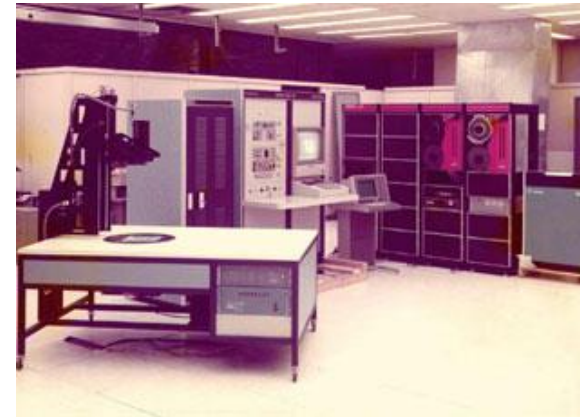
O espectro eletromagnético



- Instituto Nacional de Pesquisas Espaciais – INPE
- GE IMAGE-100, 1974
 - Sistema de Processamento de imagens
 - US\$ 1.000.000,00
 - PDP/11-45 com 128 KB de memória
 - Memória de vídeo de 512 x 512 pixels



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



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

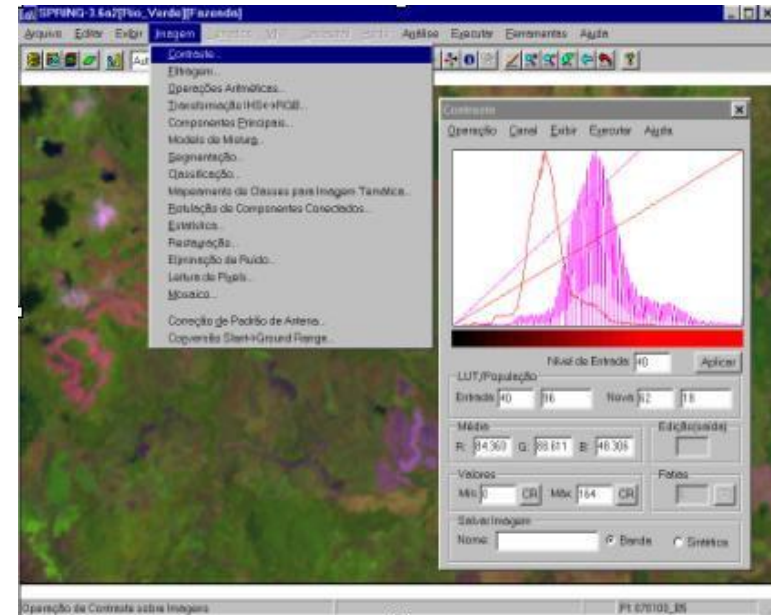
- Instituto Nacional de Pesquisas Espaciais – INPE
- SITIM – Sistema de Tratamento de Imagens, 1986
 - PC-286 com 8 MHz e 256 Kb de memória
 - Placa gráfica desenvolvida localmente
 - Imagens com até 1024 x 1024 pixels e 24 bits por pixel
 - MS-DOS



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

Processamento de imagens no Brasil

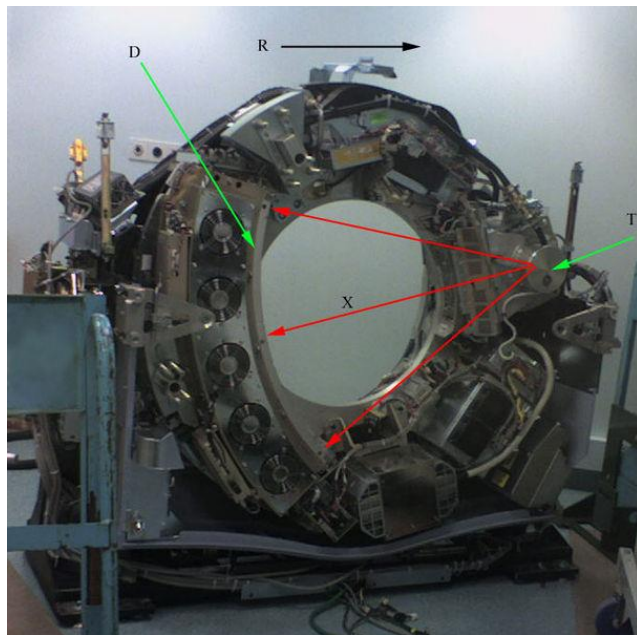
- Instituto Nacional de Pesquisas Espaciais – INPE
- SPRING – Sistema Integrado de Geoprocessamento e Processamento de Imagens, 1991
 - Interface Gráfica
 - Atualmente disponível para download
 - <http://www.dpi.inpe.br/spring/>



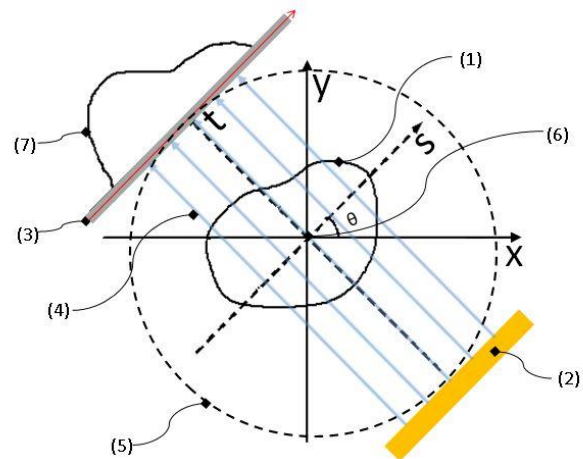
INPE: <http://www.dpi.inpe.br/DPI/institucional/pessoal/historico>

Uma aplicação de processamento de imagens

- Tomografia computadorizada
 - Allan Cormack e Newbold Hounsfield (1972)

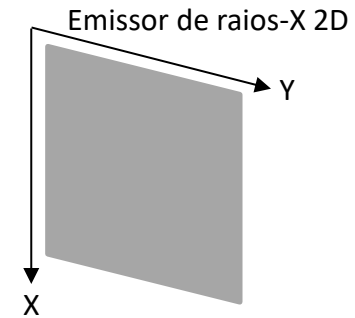
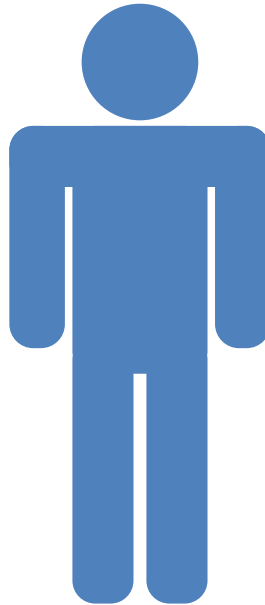


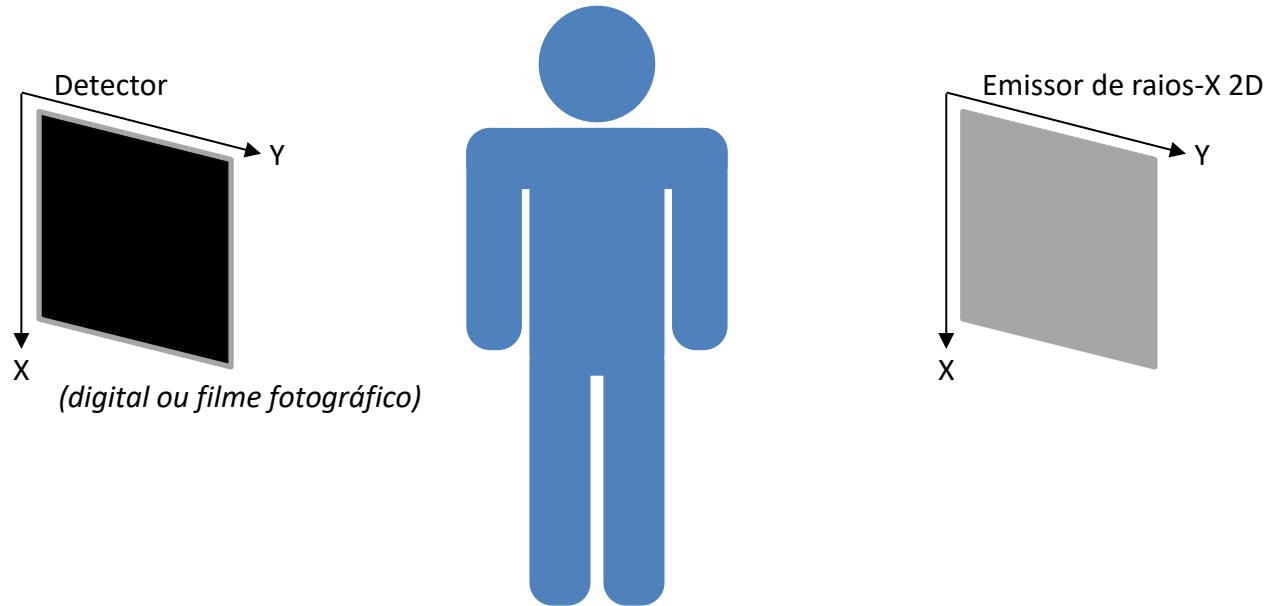
https://pt.wikipedia.org/wiki/Tomografia_computadorizada

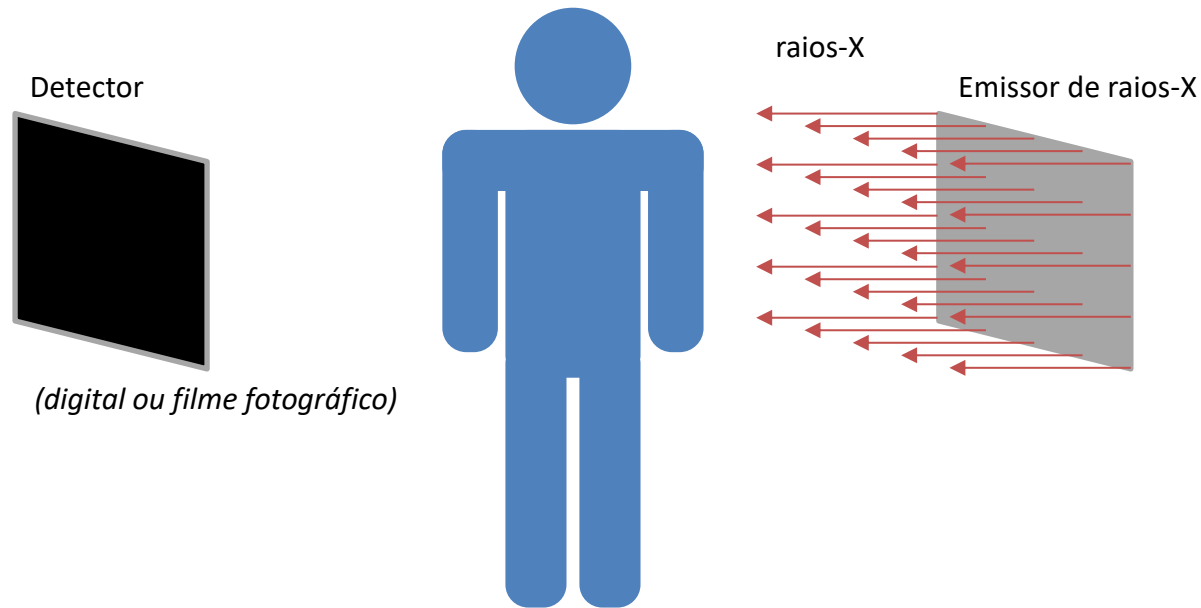


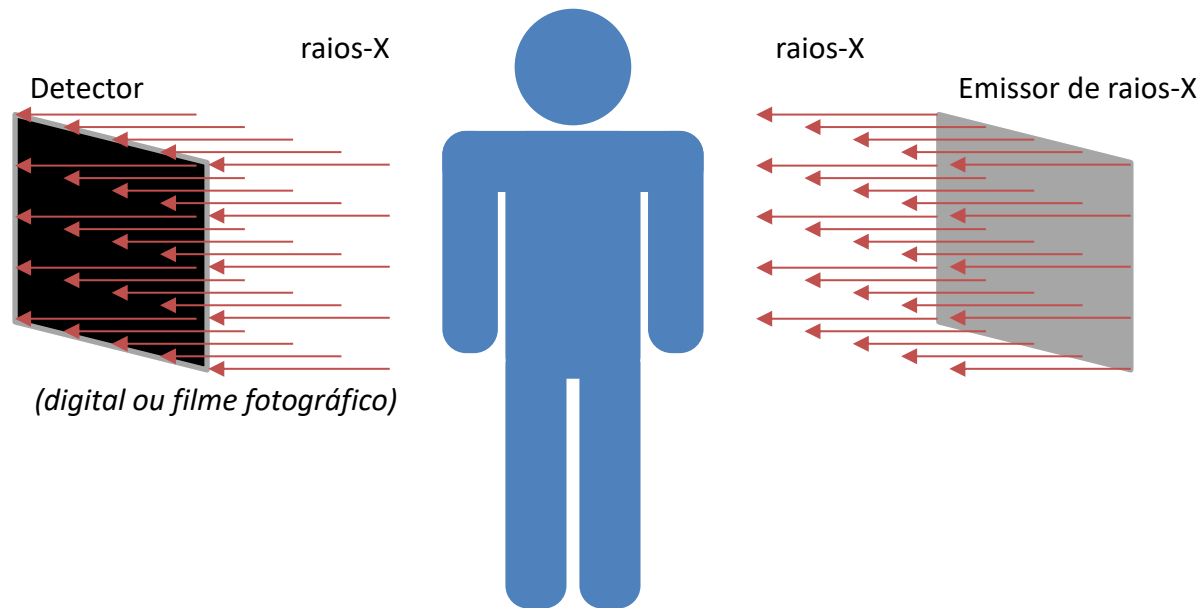
https://pt.wikipedia.org/wiki/Transformada_de_Radon

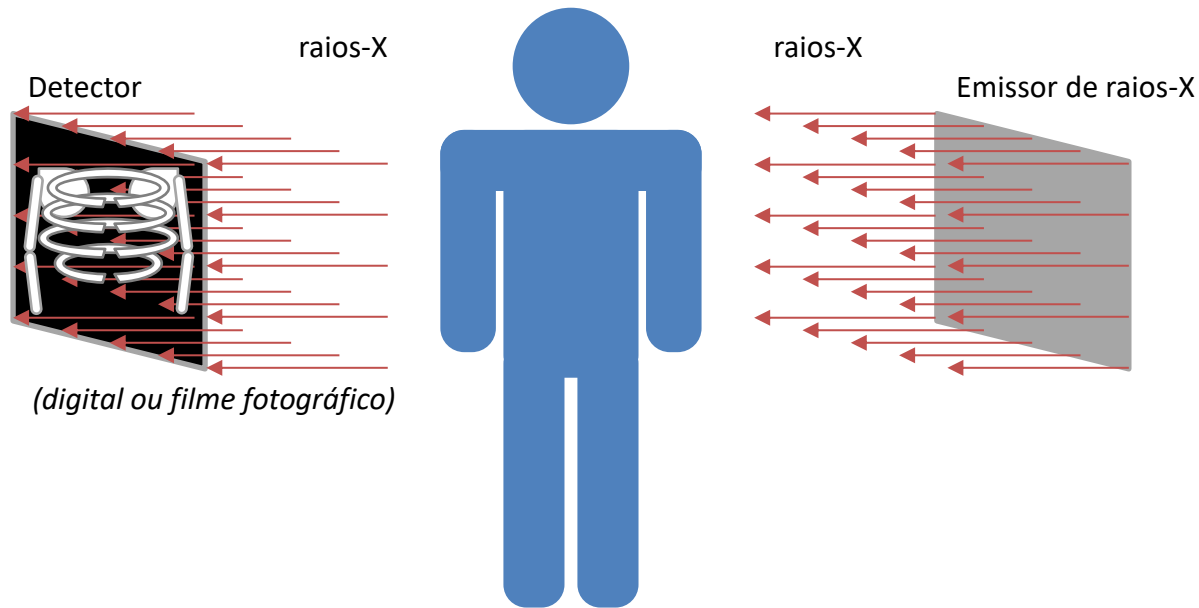
- Objeto radiografado;
- Emissor de raios X;
- Sensor;
- Feixe de raios que atravessa o objeto, sofrendo uma atenuação;
- Limites do aparelho;
- Origem dos sistemas de referência;
- Medida obtida no detector.

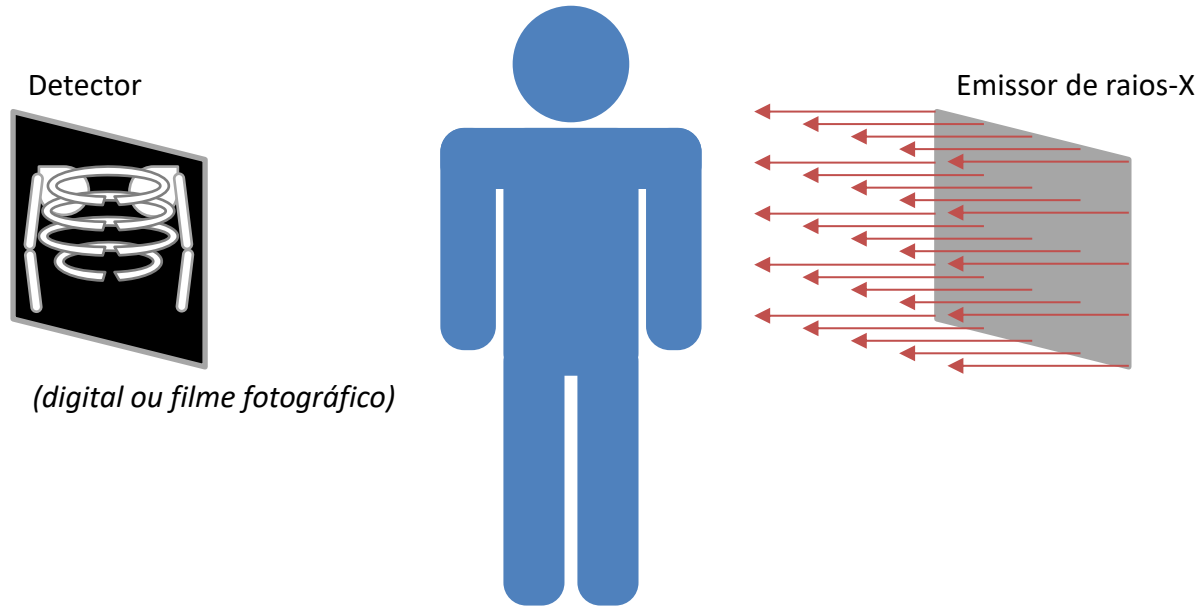




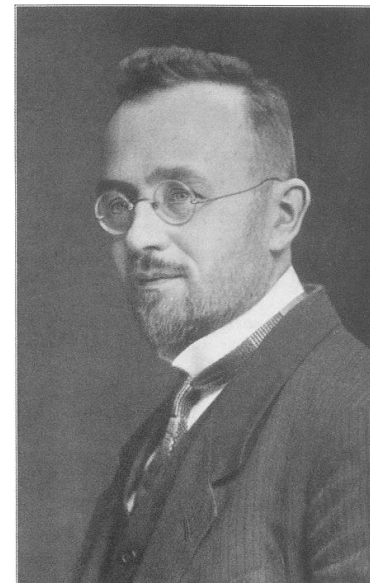
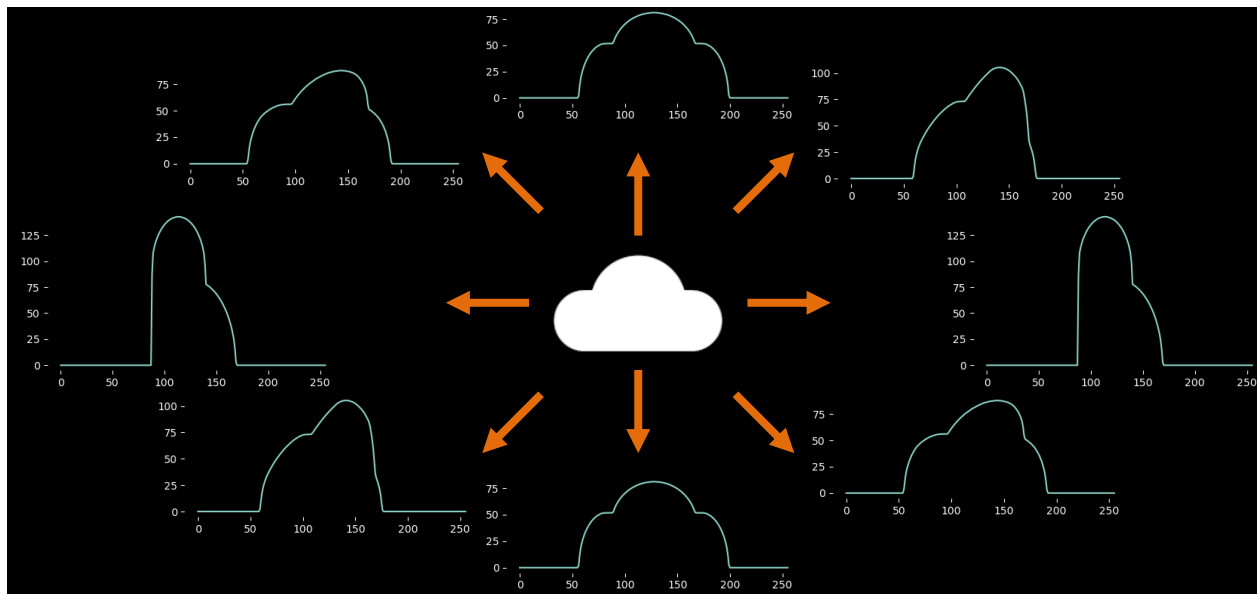
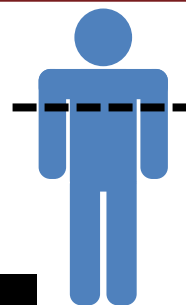






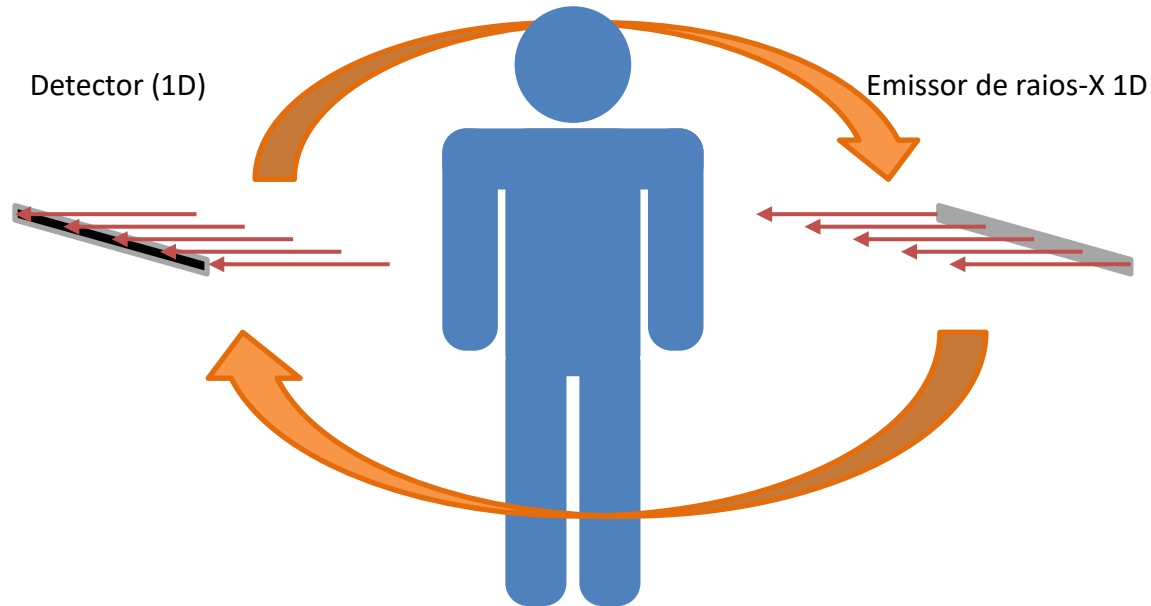


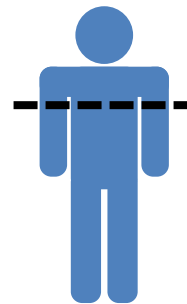
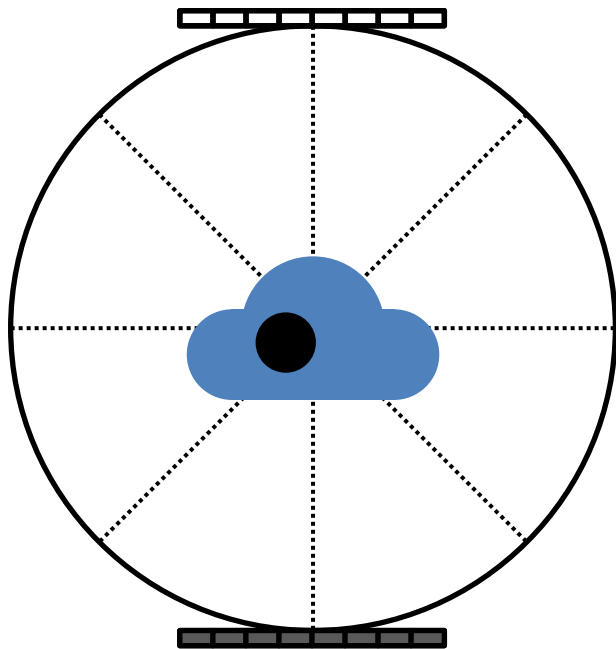
- A Transformada de Radon
 - Johann Radon (1917)
 - Reconstrução de funções a partir de projeções

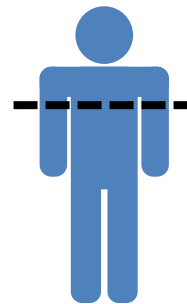
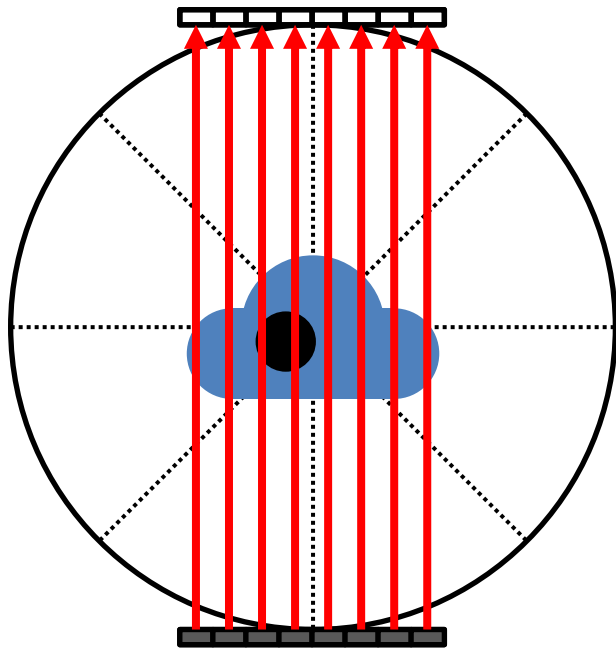


J. Radon

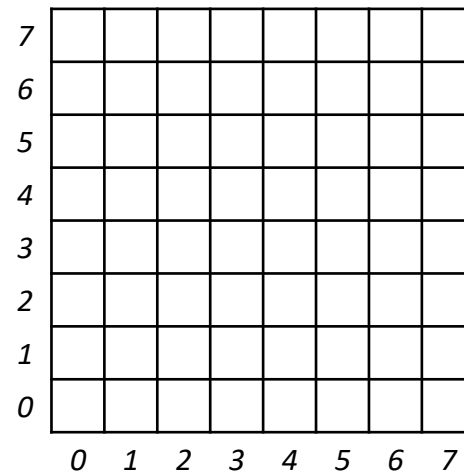
https://pt.wikipedia.org/wiki/Johann_Radon

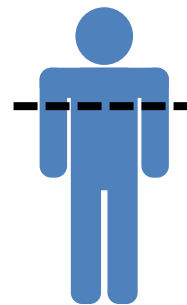
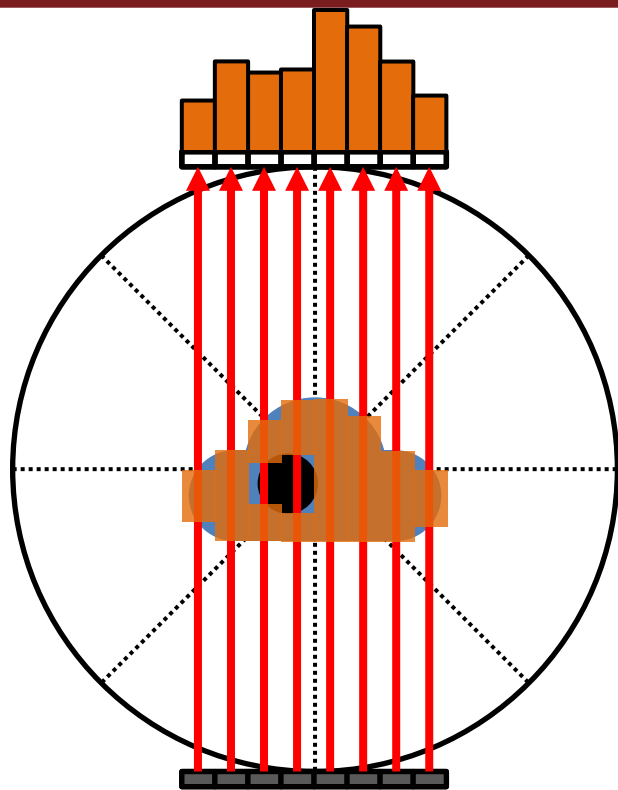




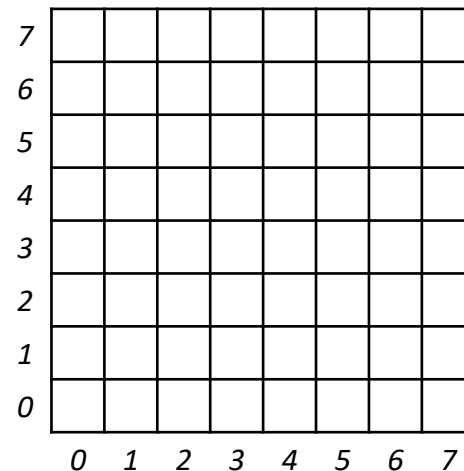


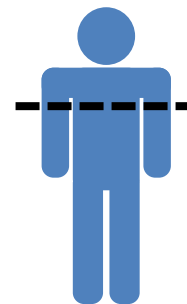
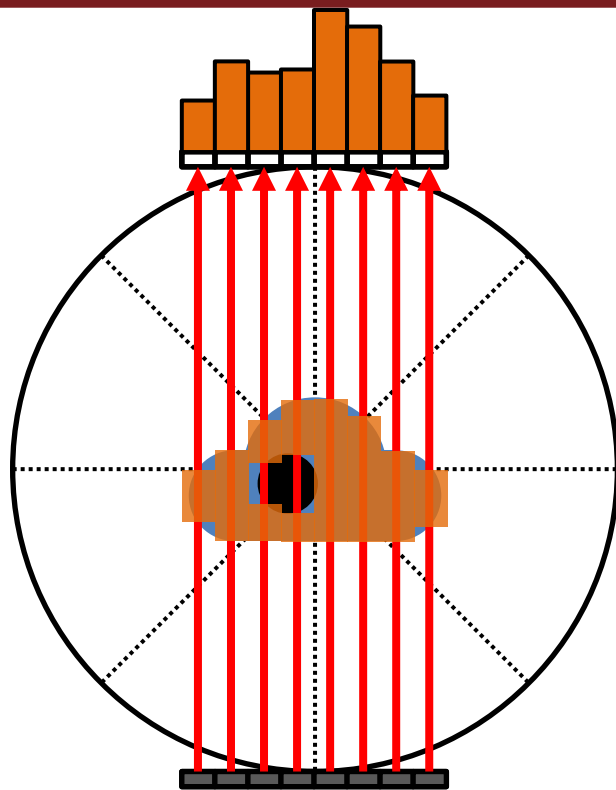
Sinograma



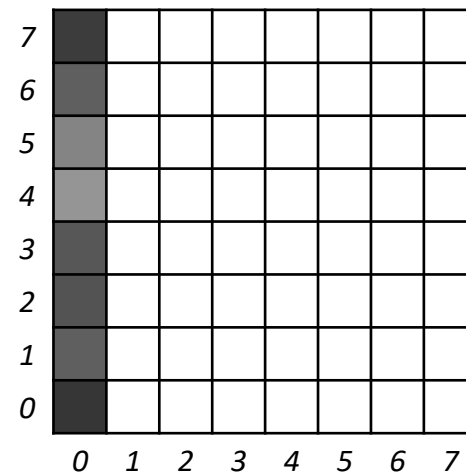


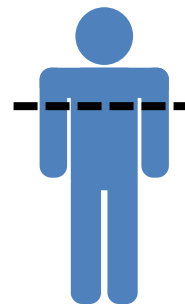
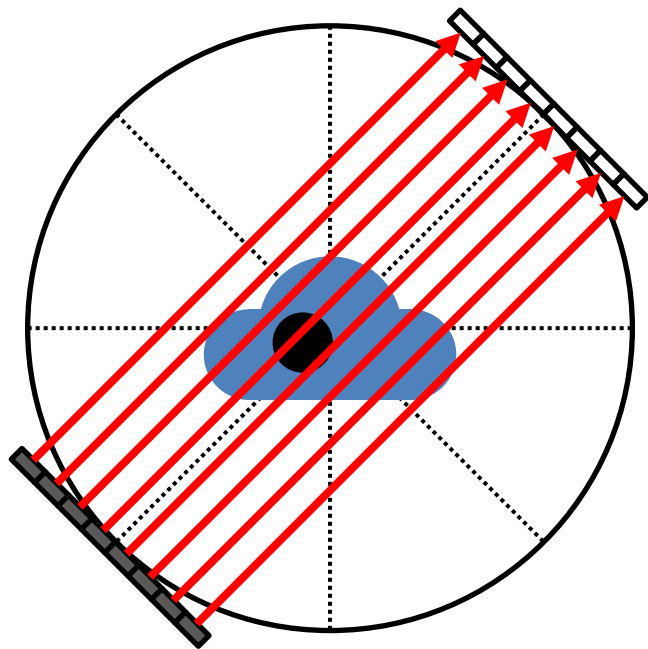
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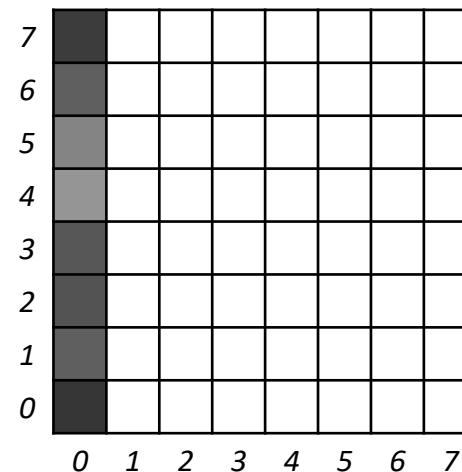


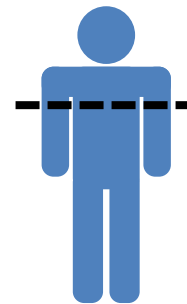
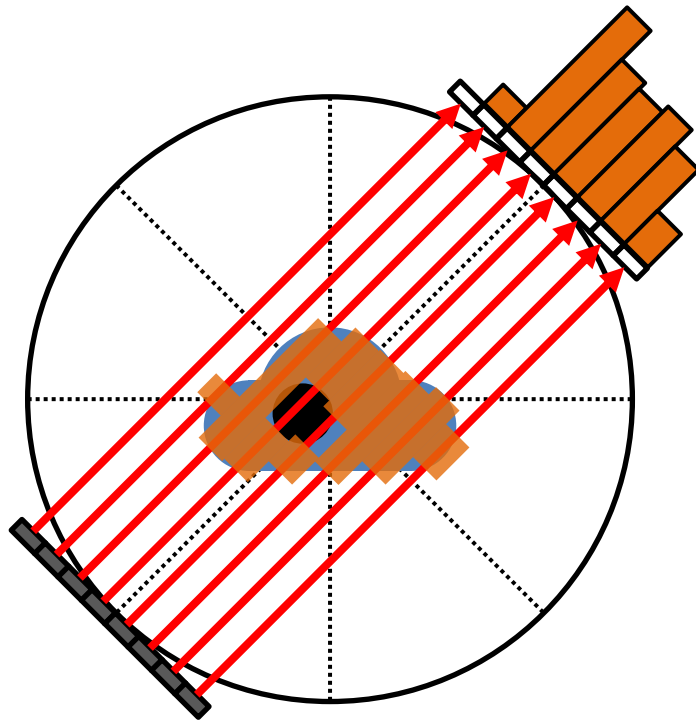
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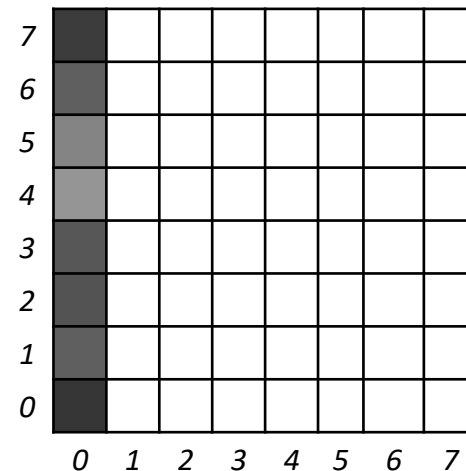


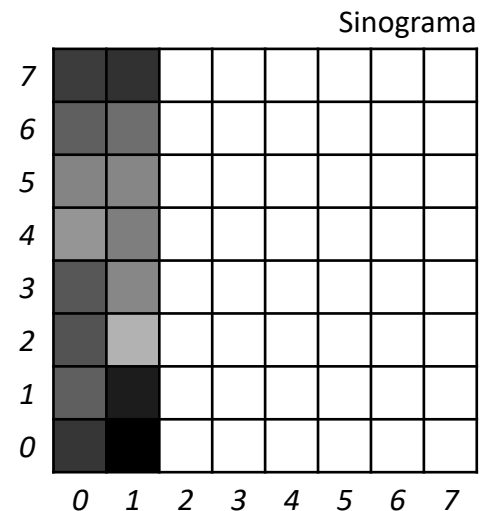
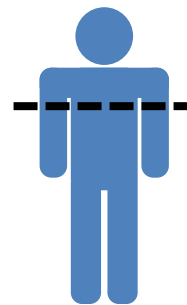
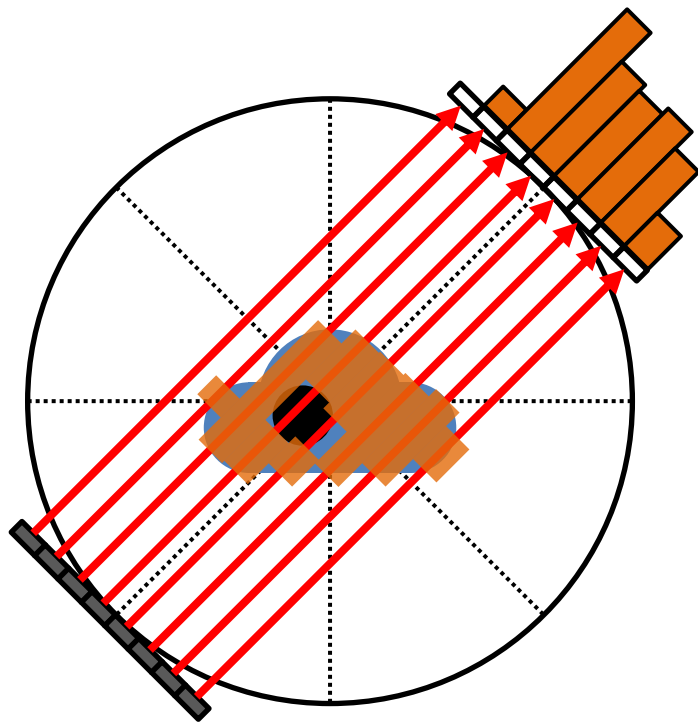
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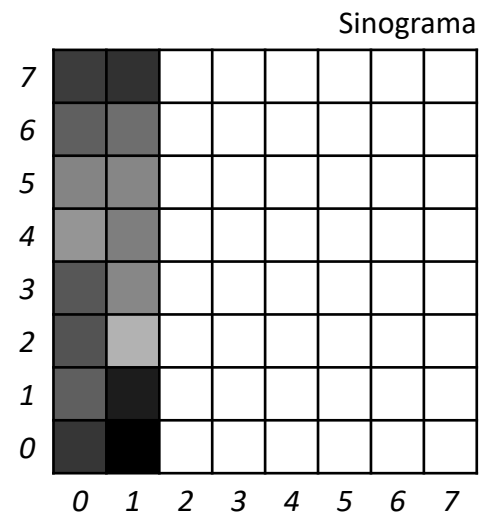
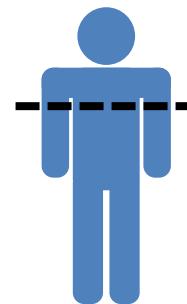
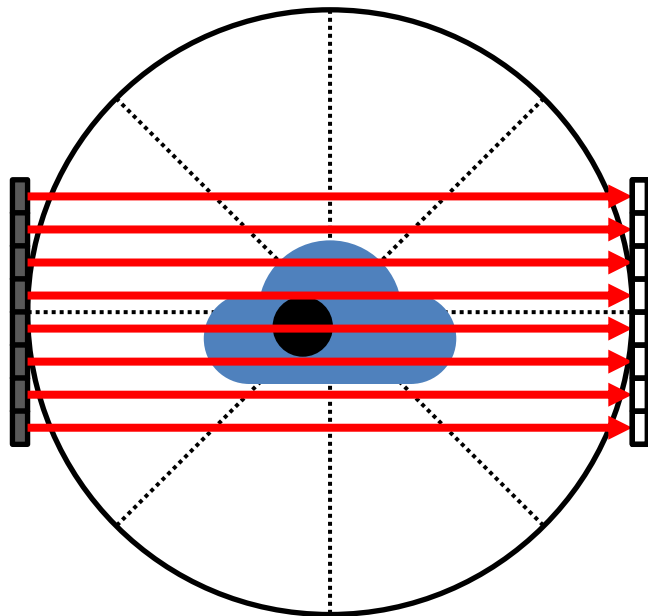


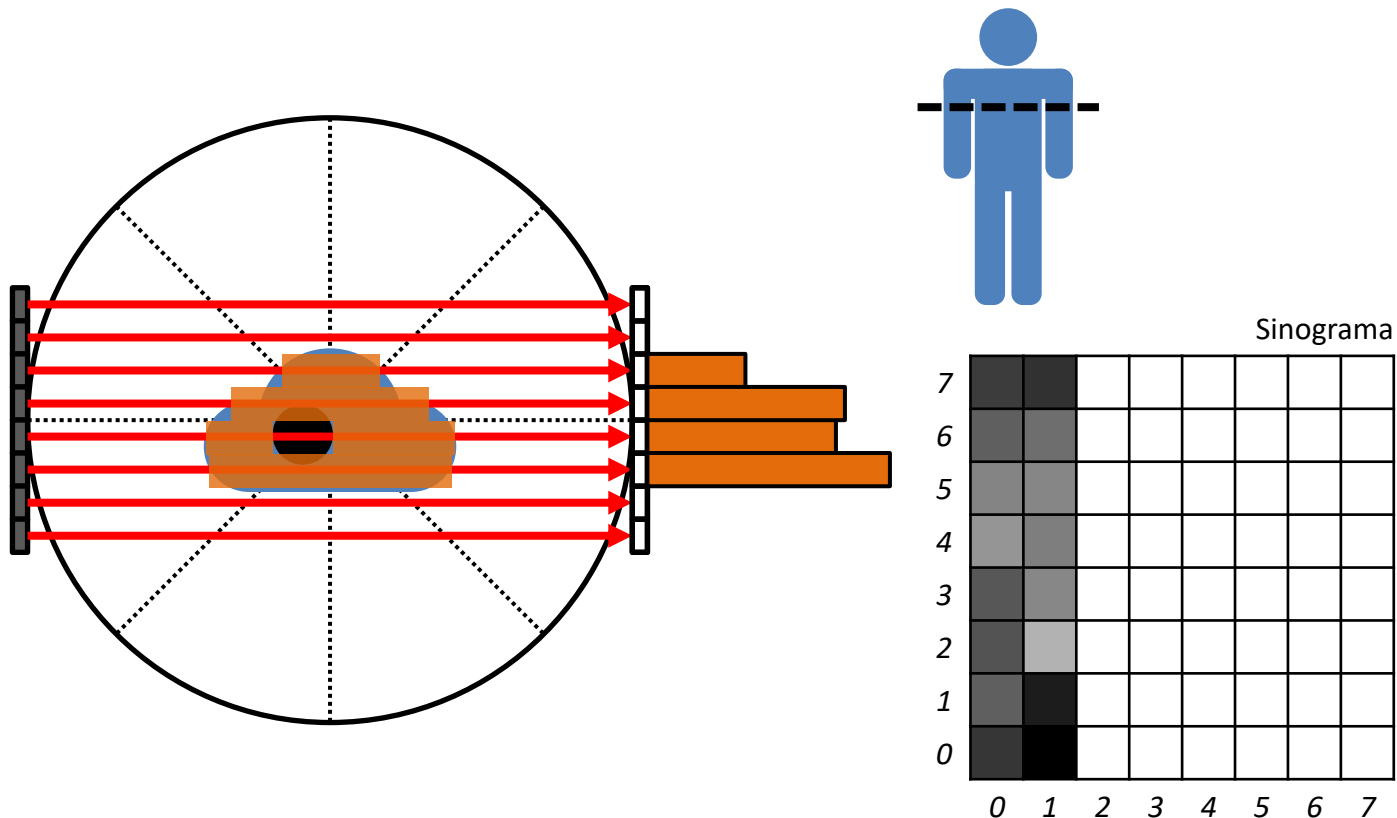


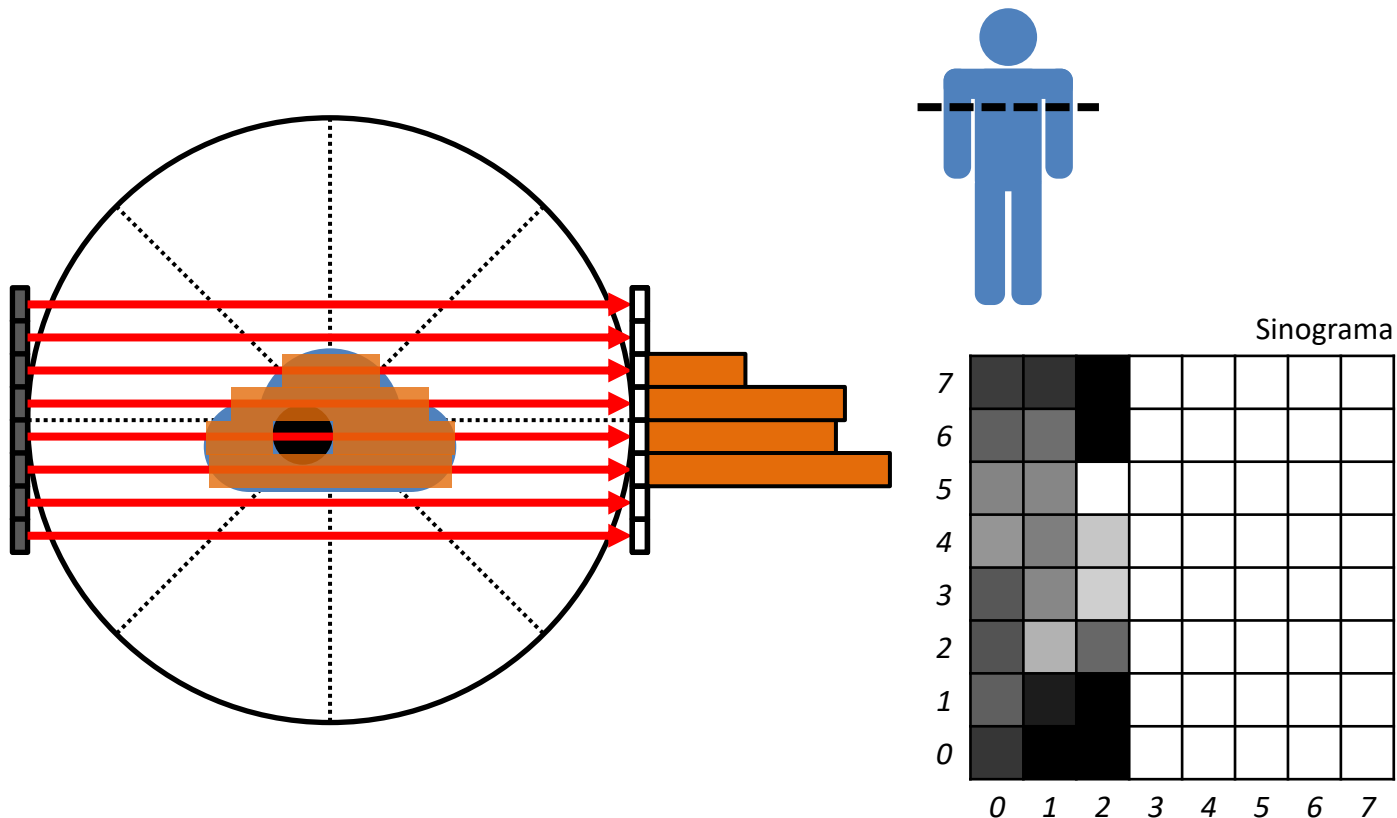
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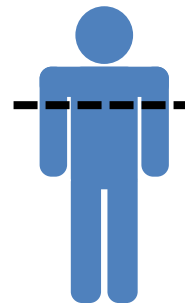
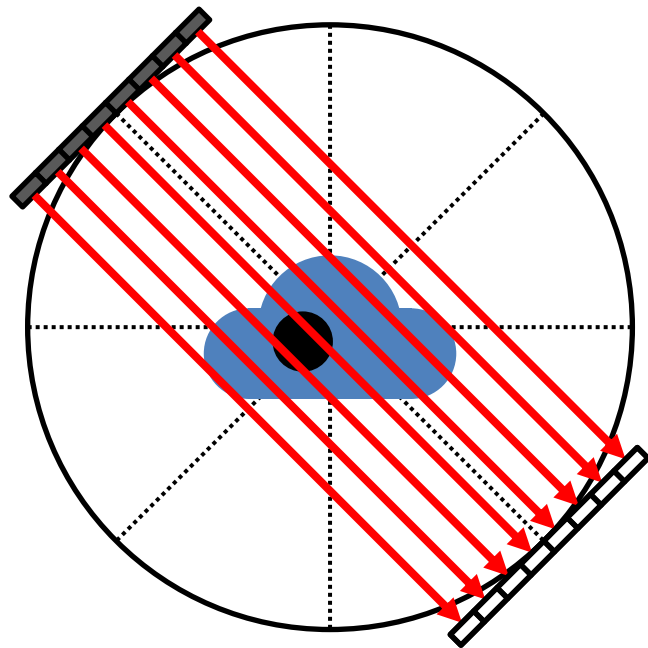




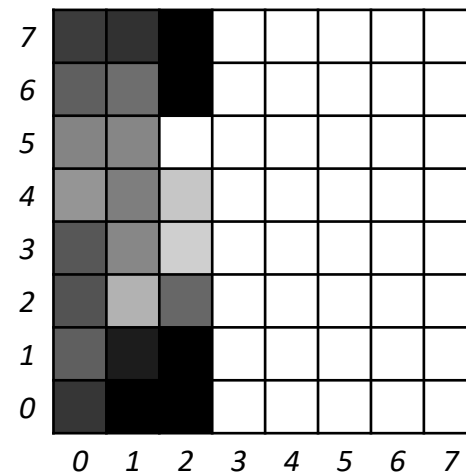


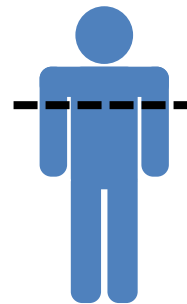
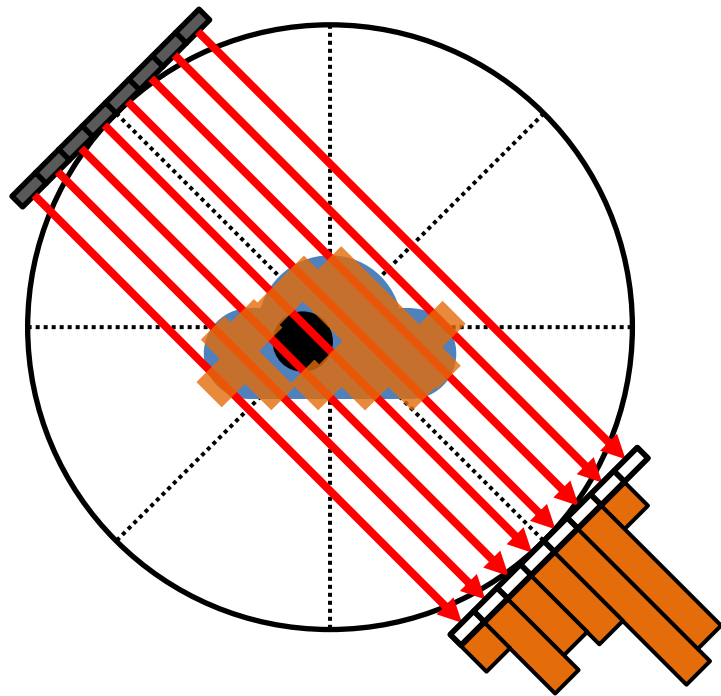




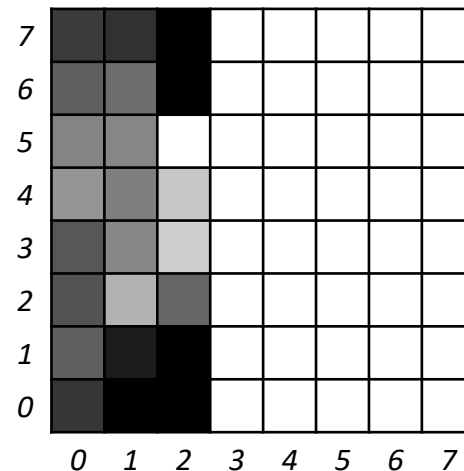


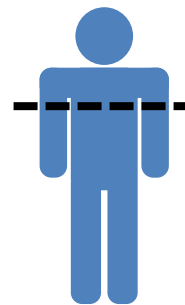
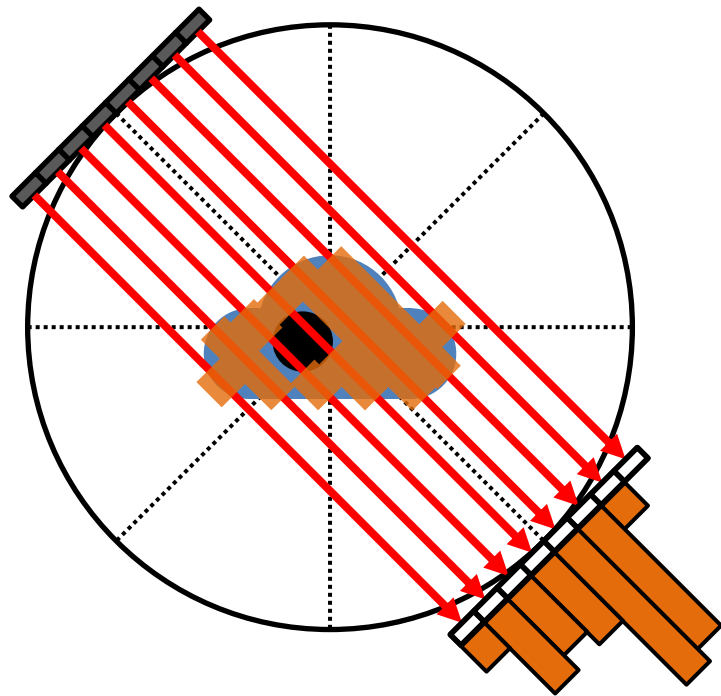
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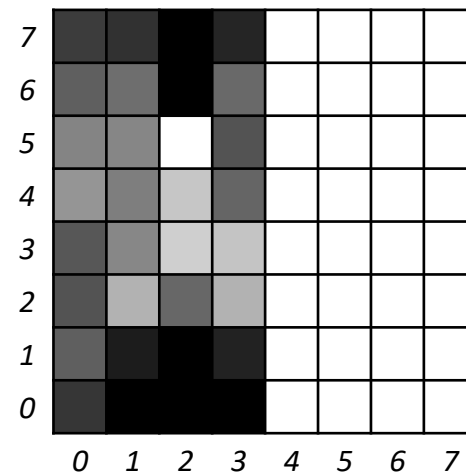


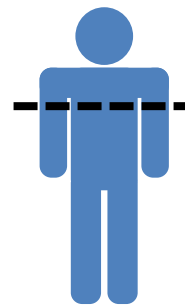
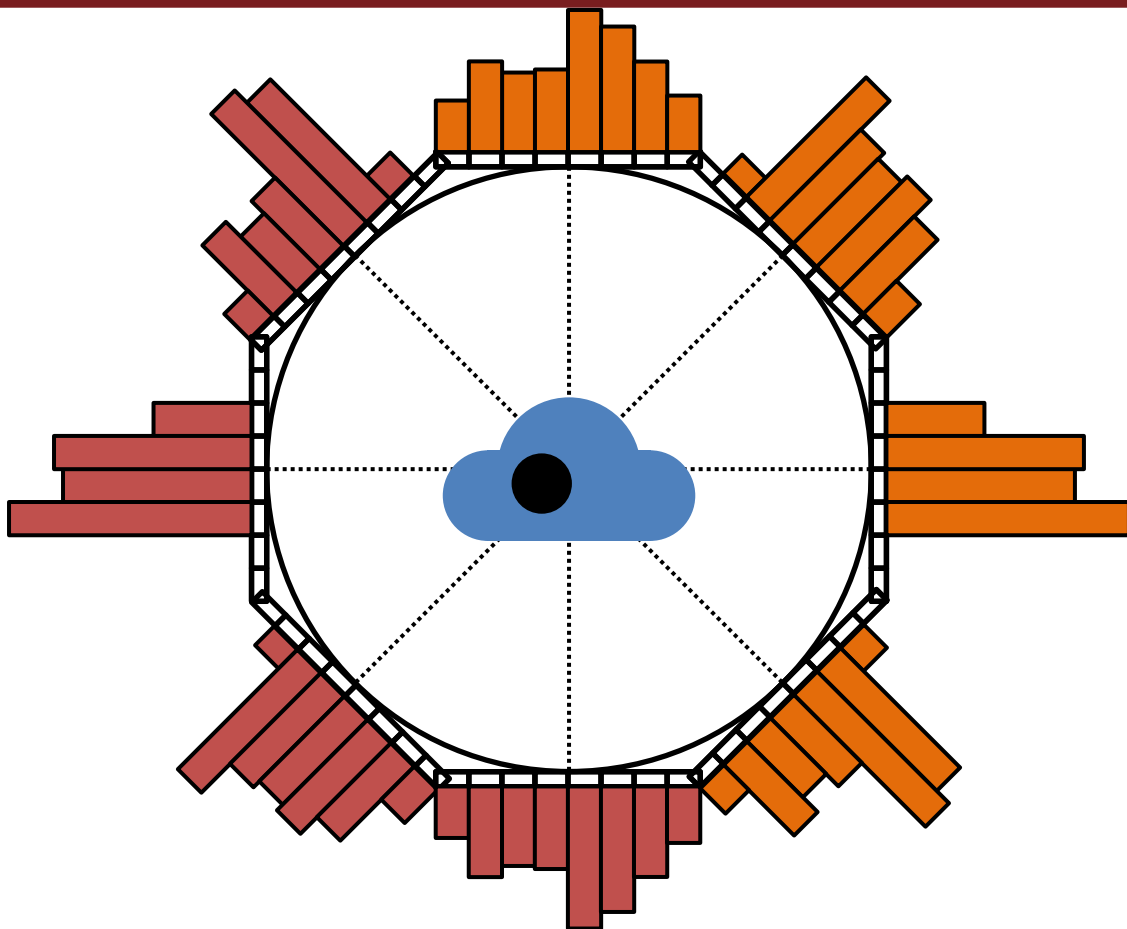
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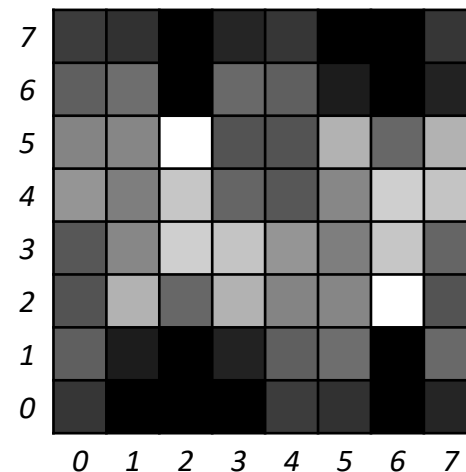


Sinograma





Sinograma



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- 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>

Bibliografia complementar

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- F. C. Billingsley "**Digital Video Processing At Jpl**", Proc. SPIE 0003, Electronic Imaging Techniques, (26 September 1965);
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FIM