



Historia algorytmu Fast Fourier Transform

*"The most important numerical
algorithm of our lifetime"*

~ Gilbert Strang

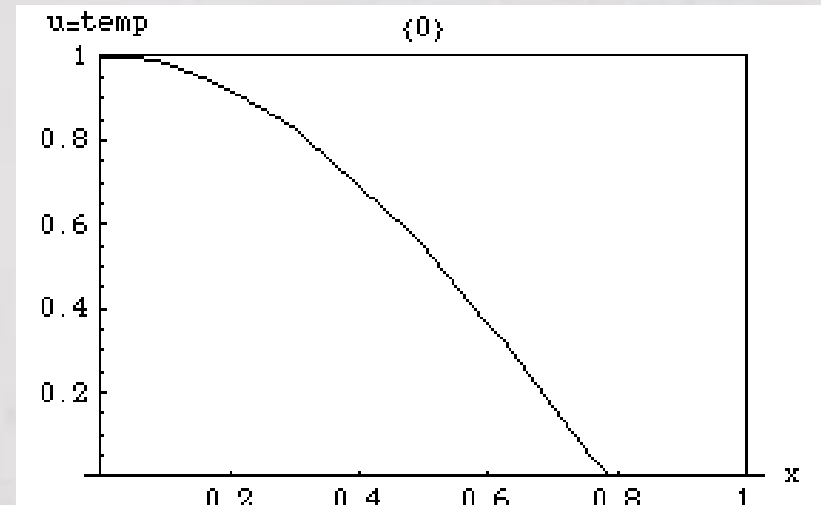
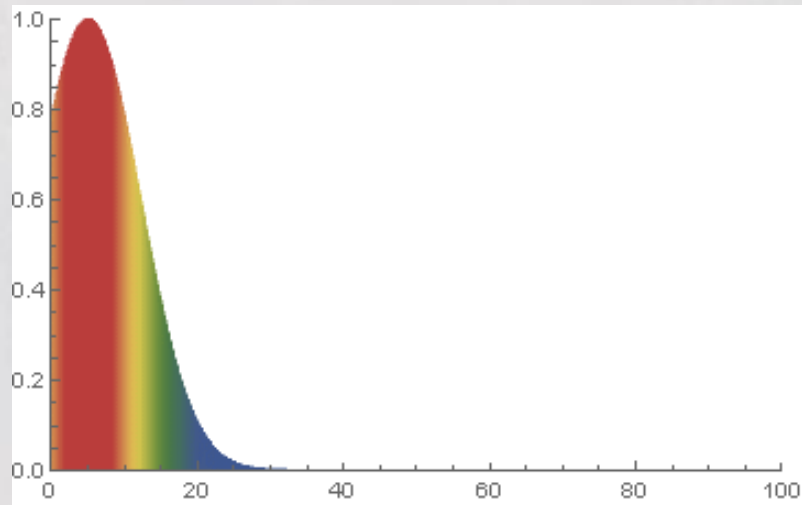
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Wydział Matematyki i Nauk Informatycznych PW
Krótki Kurs Historii Matematyki, 2024-2025



Jean Baptiste Joseph Fourier (1768 – 1830)

Równanie przewodnictwa cieplnego

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2}$$



Szereg Fouriera

$$S(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} \left[a_n \cos\left(\frac{2\pi}{T} nx\right) + b_n \sin\left(\frac{2\pi}{T} nx\right) \right]$$

$$a_n = \frac{2}{T} \int_{-T/2}^{T/2} f(x) \cos\left(\frac{2\pi}{T} nx\right) dx, \quad n = 0, 1, 2, \dots,$$

$$b_n = \frac{2}{T} \int_{-T/2}^{T/2} f(x) \sin\left(\frac{2\pi}{T} nx\right) dx, \quad n = 1, 2, 3, \dots$$

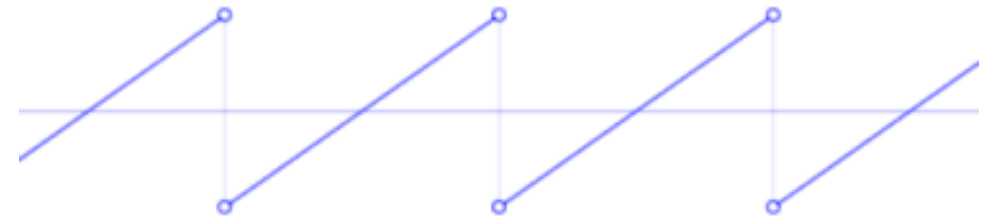
Szereg Fouriera

$$S(x) = \sum_{n=-\infty}^{\infty} c_n e^{in\omega x}$$

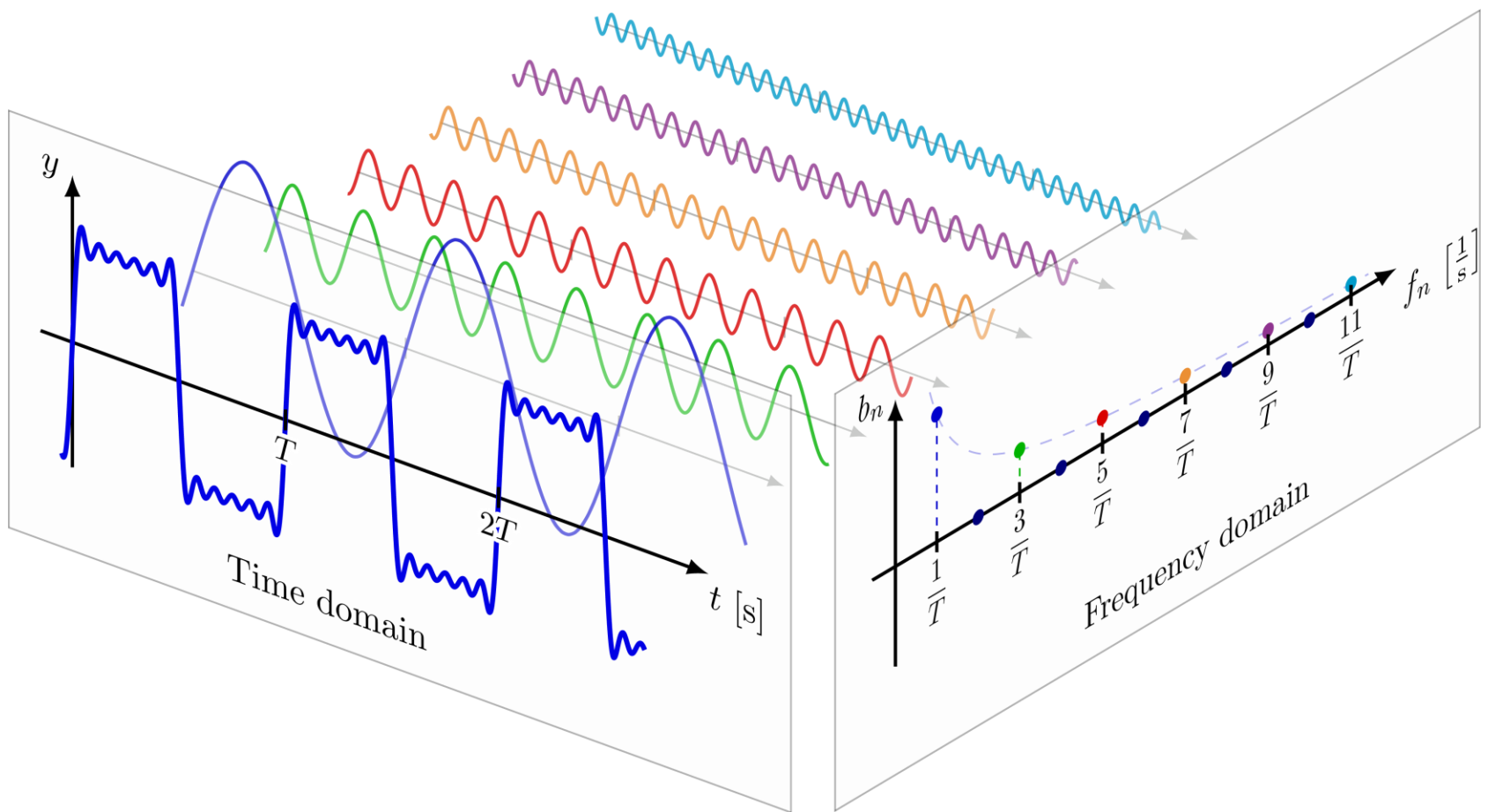
$$c_n = \frac{1}{T} \int_{-T/2}^{T/2} f(x) e^{-in\omega x} dx$$



N = 0



N = 0



Transformacja Fouriera

$$\hat{f}(\omega) = \int_{-\infty}^{\infty} f(t) e^{-i\omega t} dt$$

$$= \int_{-\infty}^{\infty} f(t) \cos(\omega t) dt - i \int_{-\infty}^{\infty} f(t) \sin(\omega t) dt$$



$f(x)$

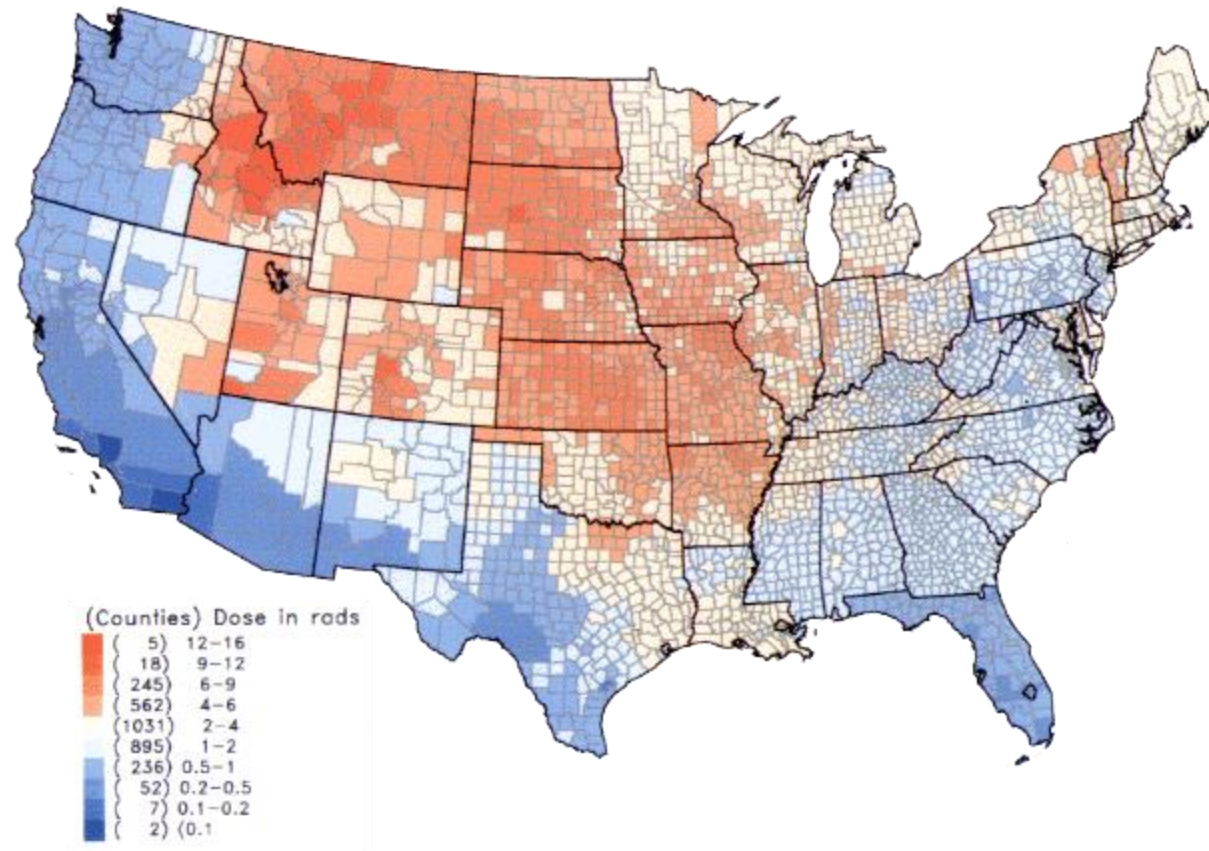
[Animacja](#)



Tło historyczne FFT



Problemy z testowaniem bomb



Problemy z testowaniem bomb

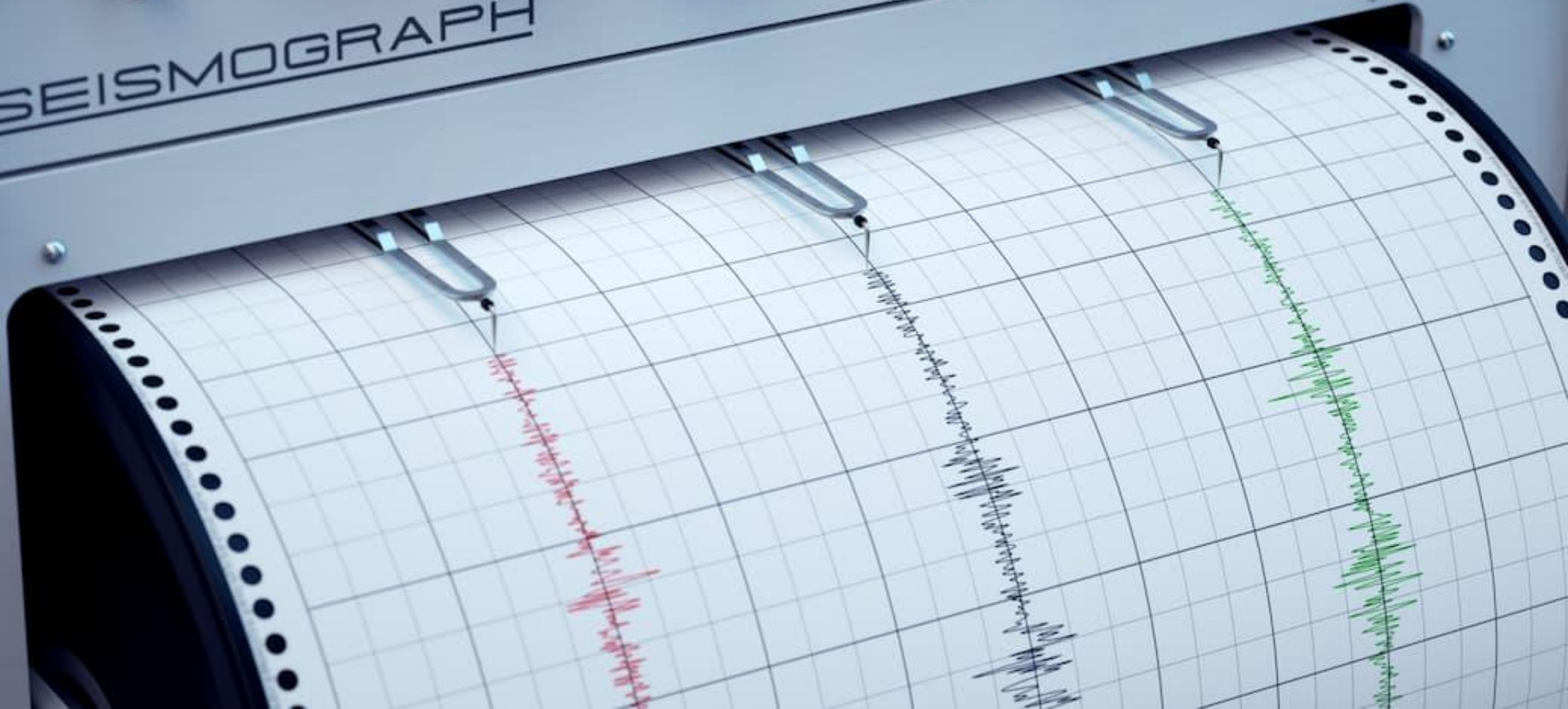
T R E A T Y

banning nuclear weapon tests
in the atmosphere, in outer
space and under water

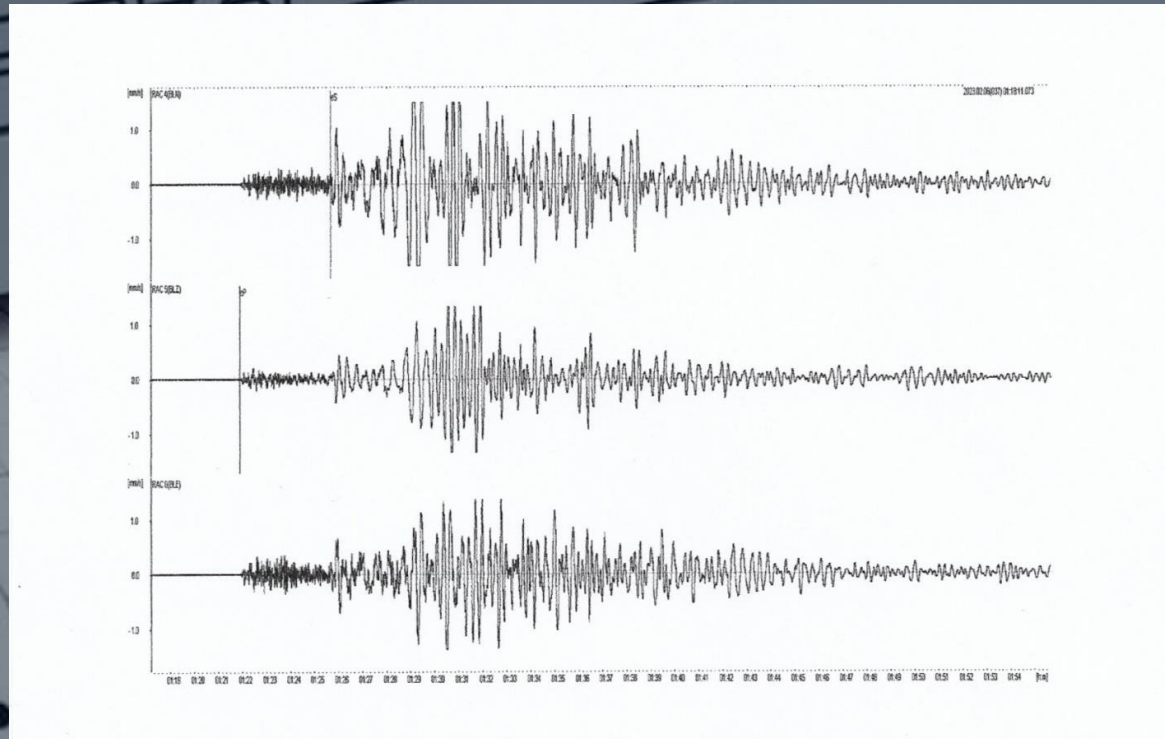
The Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland, and the Union of Soviet Socialist Republics, hereinafter referred to as the "Original Parties",

ON/OFF
STATUS

SEISMOGRAPH

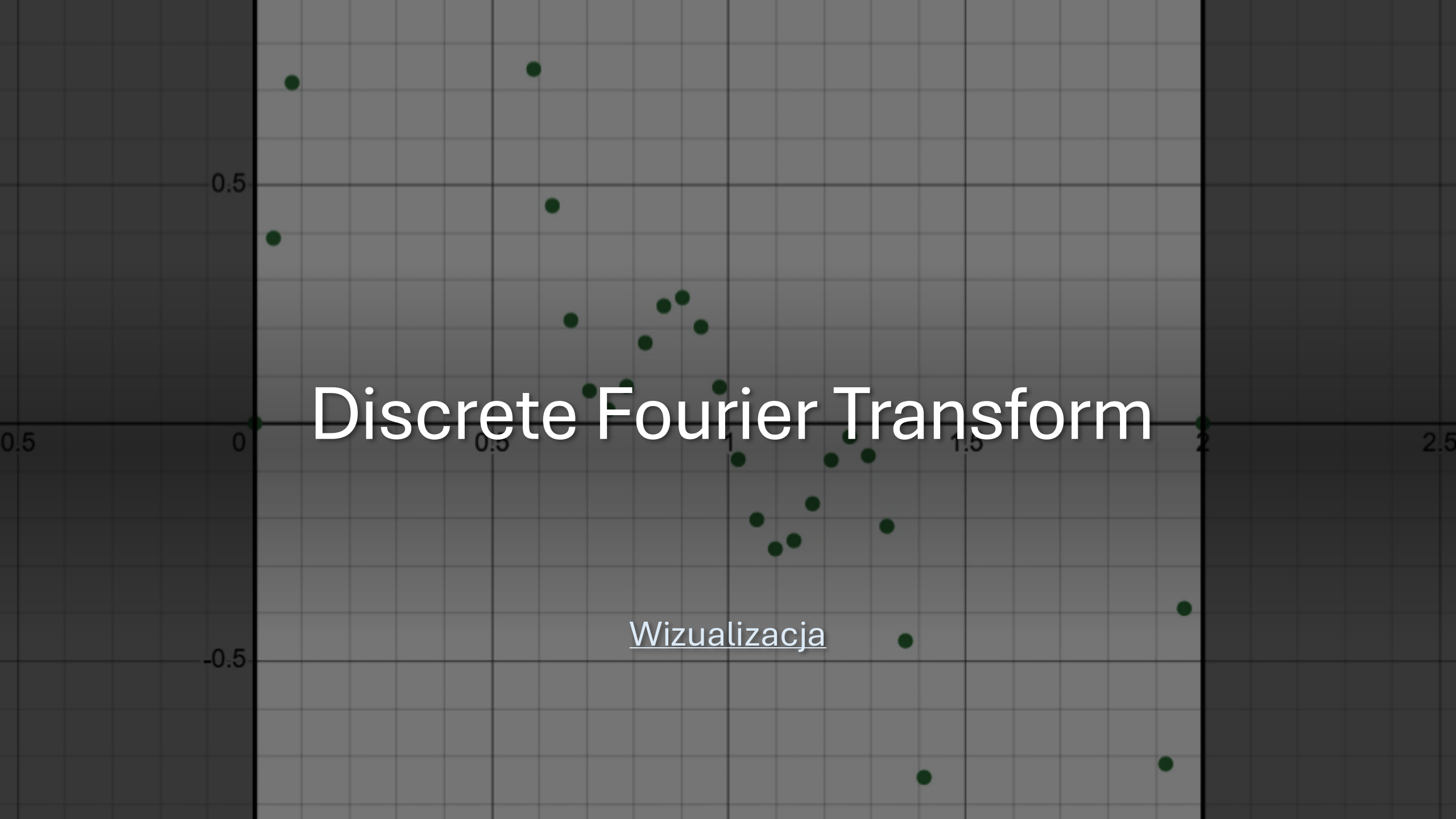


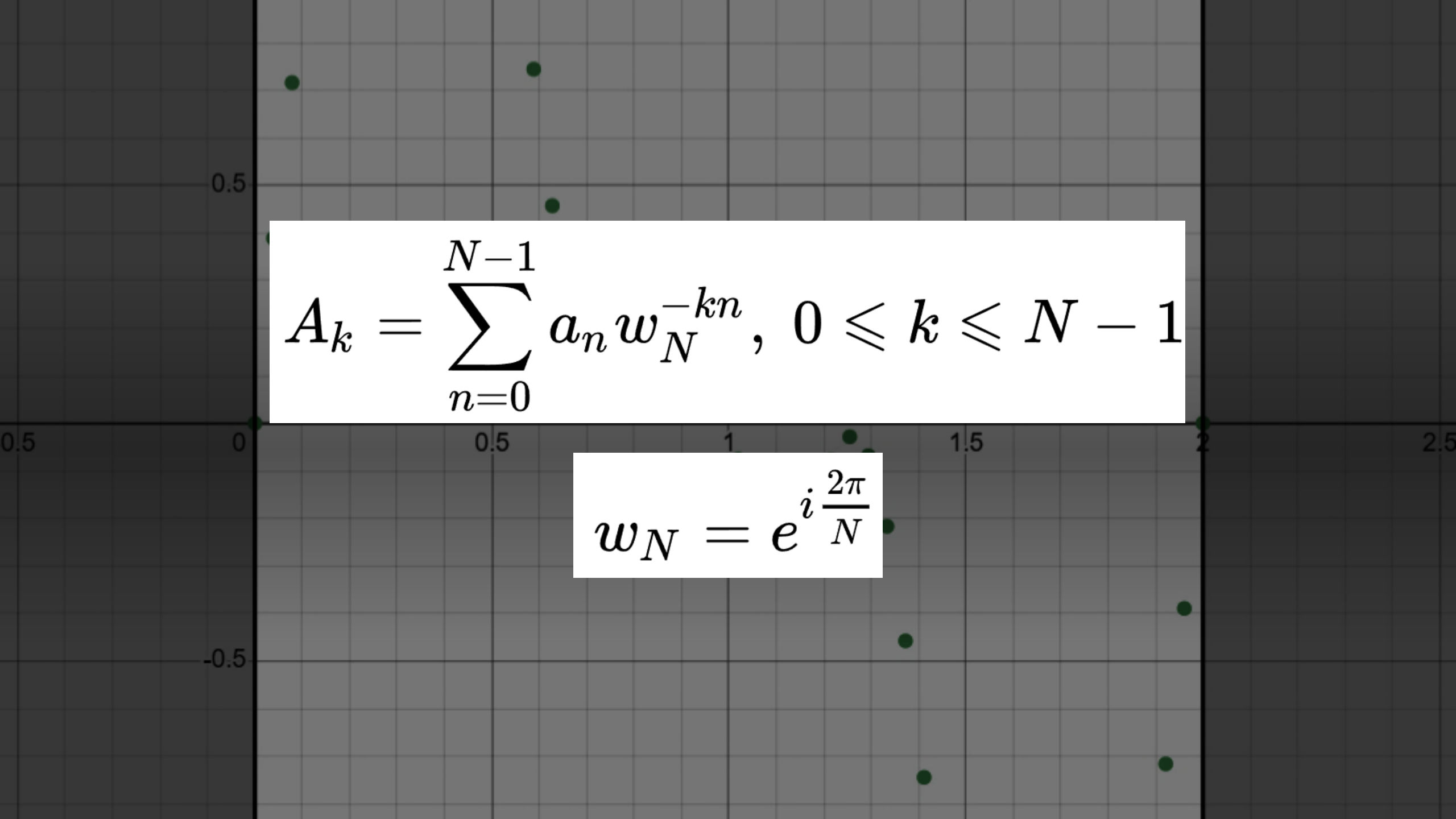
Jak odróżnić test bomby atomowej od trzęsienia ziemi?



Discrete Fourier Transform

Wizualizacja

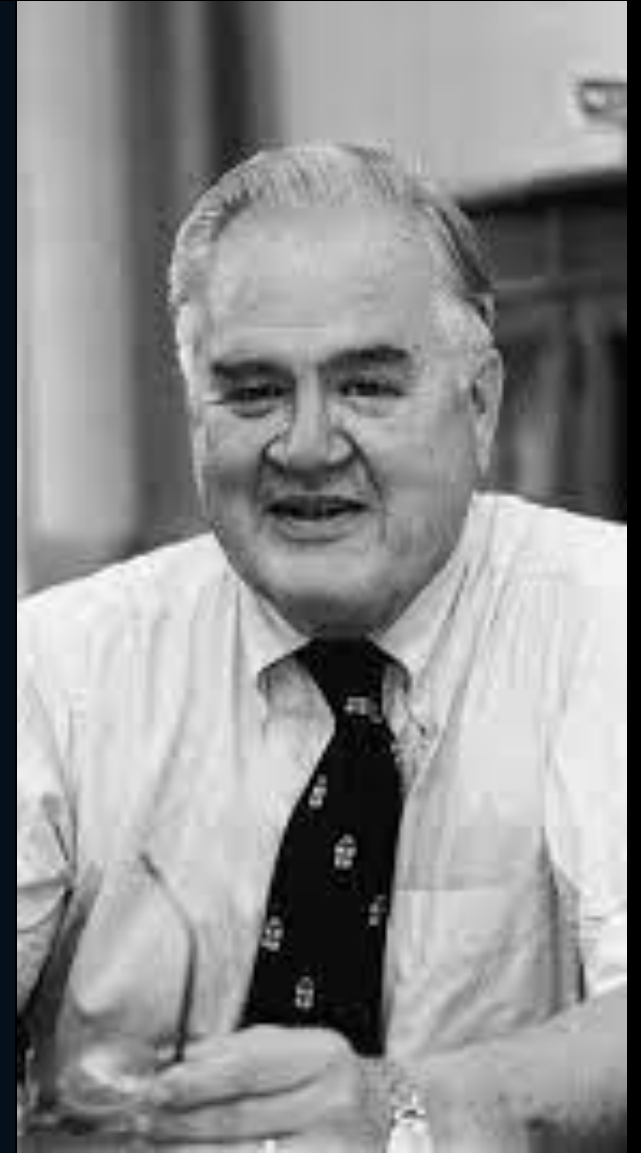



$$A_k = \sum_{n=0}^{N-1} a_n w_N^{-kn}, \quad 0 \leq k \leq N-1$$

$$w_N = e^{i \frac{2\pi}{N}}$$



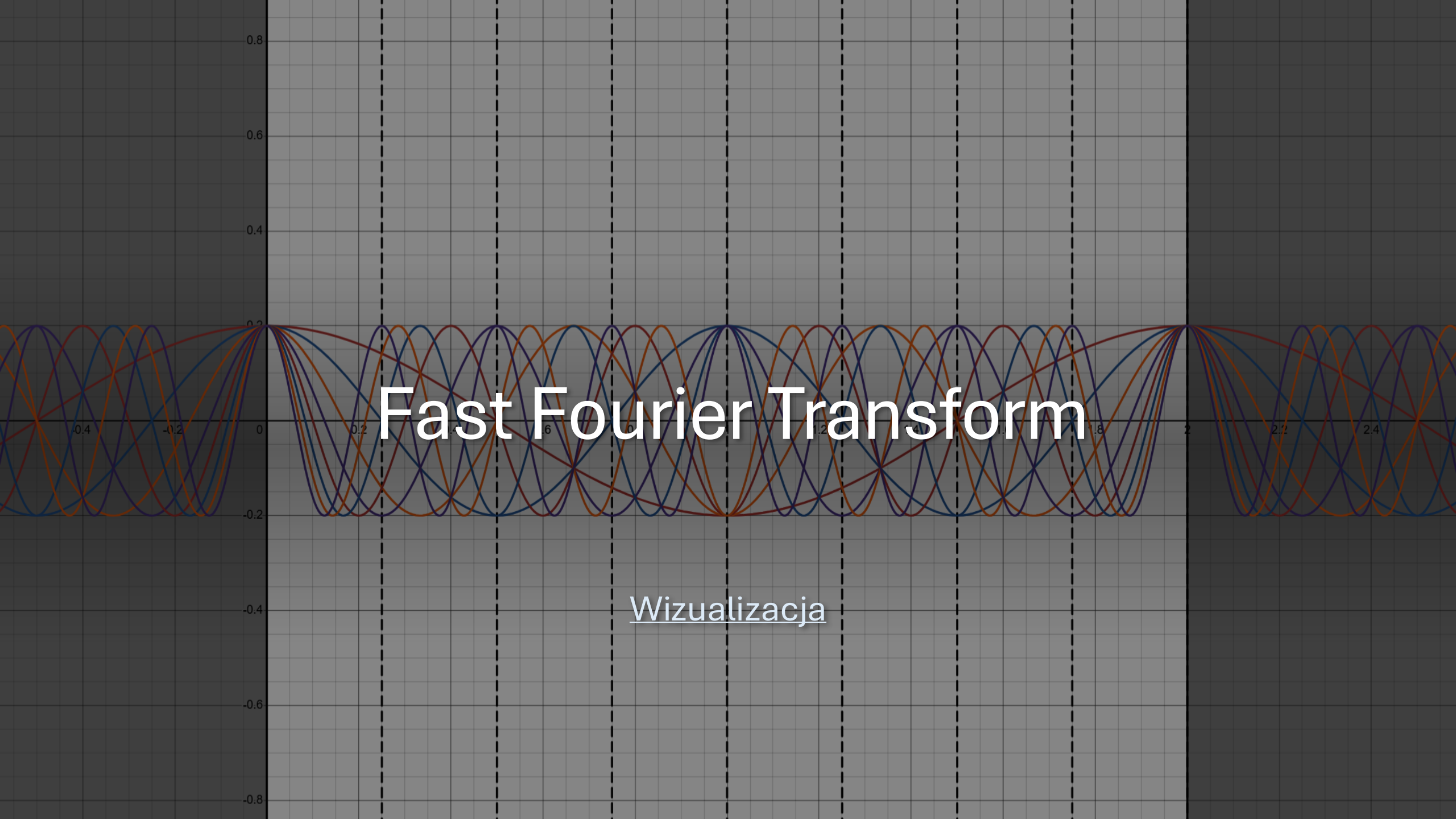
Richard Garwin



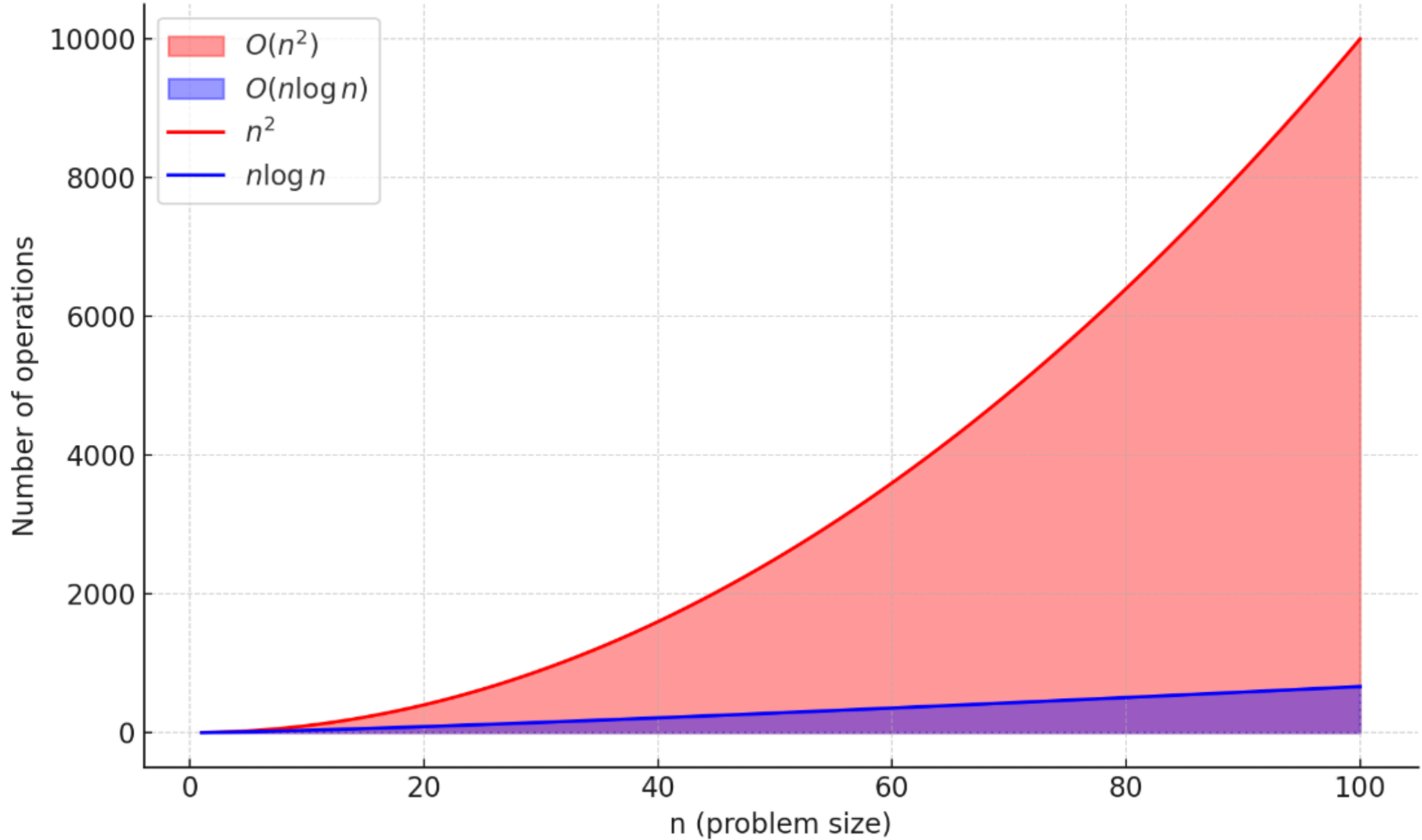
John Tuckey

Fast Fourier Transform

Wizualizacja



Comparison of $O(n^2)$ and $O(n \log n)$ Complexity



Gauss był
pierwszy?

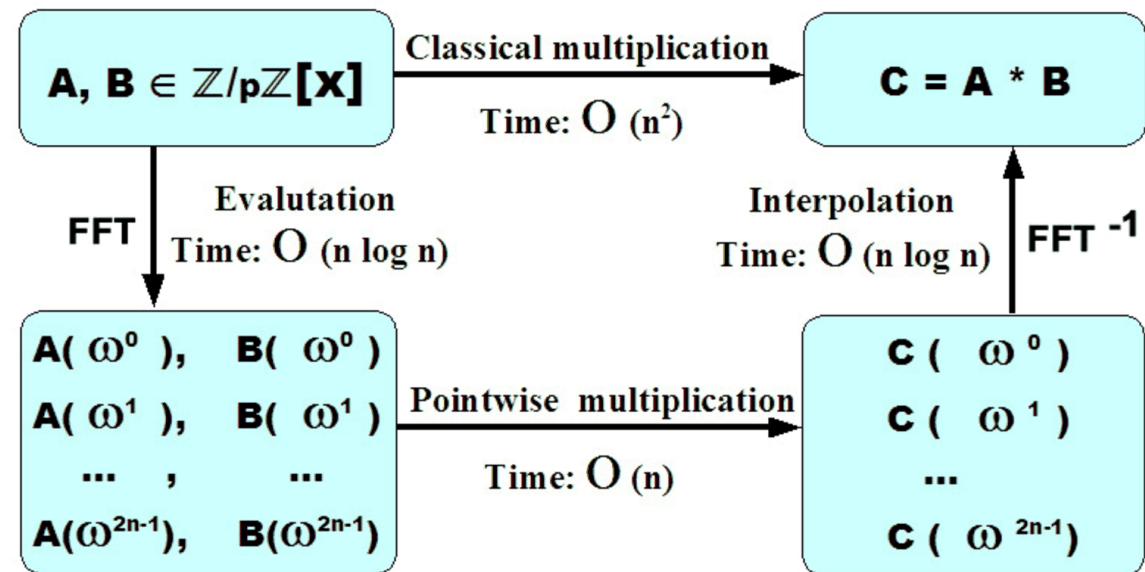
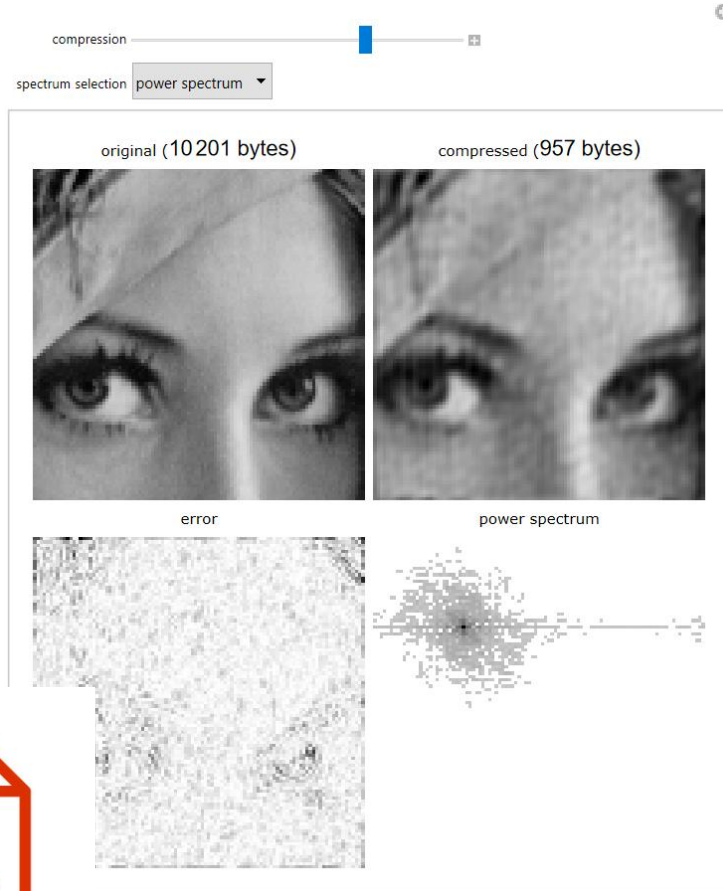


Gauss był pierwszy?



Rektoribus non caruit: plures, ut antea superioribus, longepetari in sacris tribunali-
bus desiderant, neque unquam integro illo behndu, quo plenaria indulgentia concessa
sunt, vacua fuerunt. Festum P. Angelici Adolescentis Aloysii pro more celebratum
fuit; unde, quae alia memorata fuerunt, non repetuntur. Aloysium, novum balne-
et Germaniae Traunaburgum oratione latina in choro templi, studiosa juventute
causatus, Auditoribus S. Litterarum, demonstravit unam ex magistris, Gymnas-
ium patronum suum hoc anno visa est sensisse proprium. Quidam Boetius
Alymrus, a moribus, diligentia, et profectu commendandus, eius parens uterque
vixit i morbis fatalibus, cum plus, quam bimestre, febri laboraverat, a qua
superioribus memoratum fuit; cum plus, quam bimestre, febri laboraverat, a qua
nulla medicorum arte sanari poterat. Auditis ille sol pastatis per farinam Aloy-
sianam miraculis, perhibitis medicinis, ad Angelici Adolescentis opem confugit,
sacram farinam cum fiducia sumit, addit votum, se sex diebus Dominicis in
sacram Aloysii sacram Synaxin aditurum: sumpta farina, bis adhuc, sed
est: ipsa Dominica, qua votum persolvere incipit, et

Zastosowania FFT



Dziękujemy za uwagę:)

Źródła

- <https://youtu.be/nmgFG7PUHfo?si=rwljN95KNdGVy6-g>
- https://pl.wikipedia.org/wiki/Szereg_Fouriera
- <https://dibsmethodsmeetings.github.io/fourier-transforms/>
- https://pl.wikipedia.org/wiki/Dyskretna_transformata_Fouriera
- https://en.wikipedia.org/wiki/Nevada_Test_Site