



WIKIPEDIA
The Free Encyclopedia

[Main page](#)

[Contents](#)

[Featured content](#)

[Current events](#)

[Random article](#)

[Donate to Wikipedia](#)

[Wikipedia store](#)

Interaction

[Help](#)

[About Wikipedia](#)

[Community portal](#)

[Recent changes](#)

[Contact page](#)

Tools

[What links here](#)

[Related changes](#)

[Upload file](#)

[Special pages](#)

[Permanent link](#)

[Page information](#)

[Wikidata item](#)

[Cite this page](#)

Print/export

[Create a book](#)

[Download as PDF](#)

[Printable version](#)

Languages

[Add links](#)

Article [Talk](#)

[Read](#) [Edit](#) [View history](#)

Gerchberg–Saxton algorithm

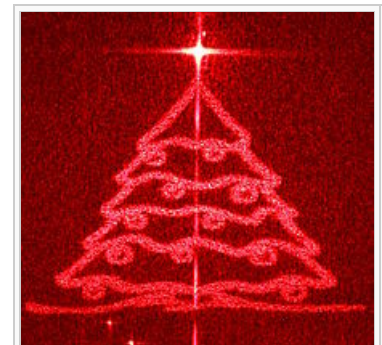
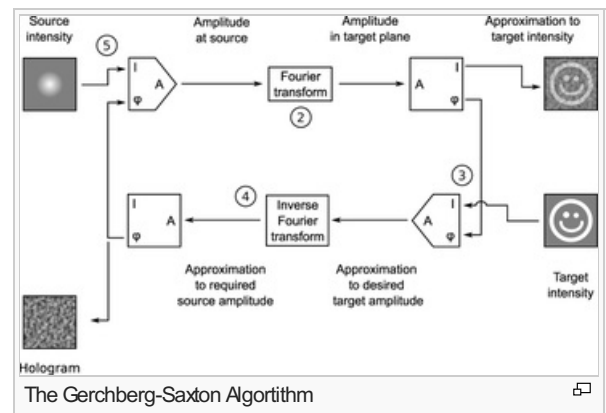
From Wikipedia, the free encyclopedia

The **Gerchberg–Saxton (GS) algorithm** is an iterative [algorithm](#) for retrieving the phase of a pair of light distributions (or any other mathematically valid distribution) related via a propagating function, such as the [Fourier transform](#), if their intensities at their respective optical planes are known.

It is often necessary to know only the phase distribution from one of the planes, since the phase distribution on the other plane can be obtained by performing a Fourier transform on the plane whose phase is known. Although often used for two-dimensional signals, the GS algorithm is also valid for one-dimensional signals.

The paper by R. W. Gerchberg and W. O. Saxton on this algorithm is entitled "A practical algorithm for the determination of the phase from image and diffraction plane pictures," and was published in *Optik* (35, 237–246 1972).

The [pseudo-code](#) below performs the GS algorithm to obtain a phase distribution for the plane, Source, such that its Fourier transform would have the amplitude distribution of the plane, Target.



The replay field of a computer generated hologram generated by the Gerchberg-Saxton algorithm. The 'star' is the zero-order diffraction peak.

Contents [\[hide\]](#)

[1 Pseudo-code algorithm](#)

[2 See also](#)

[3 References](#)

[4 External links](#)

Pseudo-code algorithm [\[edit\]](#)

Let:

FT - forward Fourier transform

IFT - inverse Fourier transform

i - the imaginary unit, $\sqrt{-1}$ (square root of -1)

exp - exponential function ($\exp(x) = e^x$)

Target and Source be the Target and Source Amplitude planes respectively

A, B, C & D be complex planes with the same dimension as Target and Source

Amplitude - Amplitude-extracting function:

e.g. for complex $z = x + iy$, $\text{amplitude}(z) = \sqrt{x \cdot x + y \cdot y}$

for real x , $\text{amplitude}(x) = |x|$

Phase - Phase extracting function:

e.g. $\text{Phase}(z) = \arctan(y/x)$

end Let

Gerchberg–Saxton Algorithm(Source, Target, Retrieved_Phase)

A = IFT(Target)

while error criterion is not satisfied

B = Amplitude(Source) * $\exp(i \cdot \text{Phase}(A))$

C = FT(B)

D = Amplitude(Target) * $\exp(i \cdot \text{Phase}(C))$

A = IFT(D)

end while

```
Retrieved_Phase = Phase(A)
end Gerchberg-Saxton Algorithm
```

This is just one of the many ways to implement the GS algorithm. Aside from optimizations, others may start by performing a forward Fourier Transform to the source distribution.

See also [edit]

- [Fourier optics](#)
- [Holography](#)
- [Adaptive-additive algorithm](#)

References [edit]

- R. W. Gerchberg and W. O. Saxton, "A practical algorithm for the determination of the phase from image and diffraction plane pictures," *Optik* 35, 237 (1972)
- Press, WH; Teukolsky, SA; Vetterling, WT; Flannery, BP (2007). "[Section 19.5.2. Deterministic Constraints: Projections onto Convex Sets](#)" [↗]. *Numerical Recipes: The Art of Scientific Computing* (3rd ed.). New York: Cambridge University Press. ISBN 978-0-521-88068-8.

External links [edit]

- [Graphical explanatory material by Kevin Cowtan](#) [↗]
- [Dr W. Owen Saxton's page](#) [↗]
- [Applications and publications on phase retrieval from the University of Rochester, Institute of Optics](#) [↗]

Categories: [Digital signal processing](#) | [Physical optics](#)

This page was last modified on 7 April 2015, at 11:20.

Text is available under the [Creative Commons Attribution-ShareAlike License](#); additional terms may apply. By using this site, you agree to the [Terms of Use](#) and [Privacy Policy](#). Wikipedia® is a registered trademark of the [Wikimedia Foundation, Inc.](#), a non-profit organization.

[Privacy policy](#) [About Wikipedia](#) [Disclaimers](#) [Contact Wikipedia](#) [Developers](#) [Mobile view](#)

