Optica Applicata, Vol. XXVII, No. 1 1997

Letters to the Editor

"Point of inflexion" in coherent scanning microscope $\cos^2[Nx]$ in apodizer

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In paper [1], an extended study of coherent diffraction imaging of a slit in a coherent annular scanning microscope (CSM) apodized by Lanczos filter was presented and the value of the "point of inflexion" determined. The point of inflexion defines a particular value of half-widths of clear slit $u_{0\text{infl}}$ for which the central peak of the intensity distribution in the slit image changes its curvature from convexity to concavity. For a constant controlling parameter β of the Lanczos apodizer transmittance the value of $u_{0\text{infl}}$ diminish within the range of obstruction valuess of the annular pupil ($0 < \varepsilon < 0.5$) and increase within the range $0.5 < \varepsilon < 1$. For constant β there appears only one value $u_{0\text{infl}}$. In paper [2], the coherent diffraction imaging of a clear slit in CSM and C2P with an apodizer in the form of squared sinusoidal grating of amplitude type were presented. By applying the apodizer of the form of a grating of amplitude squared cosine $\cos^2[Nx]$ for $N = 1, 3, 5, 7, 10$ it was shown that many values of the point of inflexion appear in CSM with circular pupil.

Taking advantage of intensity distribution in the clear slit image reported in paper [1] for squared cosine $\cos^2[Nx]$ filter we obtain

$$I(u) = \left[4u_0 \int_0^1 \frac{\sin(2\pi u_0 x)}{(2\pi u_0 x)} (\cos^2[Nx]) \cos(ux) \mathrm{d}x \right]^2 \tag{1}$$

where u_0 is a half-width of the slit.

From the condition

$$\Delta = \left. \frac{\partial^2}{\partial u^2} \right|_{u=0} = 0 \tag{2}$$

the values of the point of inflexion were determined. In Figs. 1a-e, the dependence (2) determined numerically is shown, while in the table the values of the point of inflexion obtained for N = 1, 3, 5, 7, 10 are presented, respectively. For $u_0 = u_{0\text{infl}}$, from formula (1), the intensity distribution $I(u_{0\text{infl}})$ in a clear slit image has been obtained. In Figures 2 and 3, some examples of the cases of $I(u_{0\text{infl}})$ for $N = 7$ at the

points $u_{0\,\mathrm{infl}\,1}$ (Fig. 1) and $u_{0\,\mathrm{infl}\,3}$ (Fig. 2) are shown, while in Figs 4 and 5 $I(u)$ outside the point of inflexion is presented. In the points of inflexion the most reliable clear slit image was obtained.

T a b l e. "Point of inflexion" values in CSM with $\cos^2[Nx]$ apodizer for $N = 1, 3, 5, 7, 10$.

$N = 1$	$N = 3$	$N = 5$	$N = 7$	$N = 10$
0.823508	0.60154	0.780364	0.667868	0.682677
1.2942	1.10031	1.50833	1.14049	1.16859
1.78122	1.71213	2.34012	1.5996	1.63811
2.27412	2.225	2.89788	2.21986	2.09487
2.76966	2.73087	3.44501	2.87145	2.5485
3.26659	3.23437	3.98509	3.35362	3.18991
3.76436	3.73673	4.51841	3.83778	3.848
4.26265	4.23845	—	4.32562	—
4.76132	4.73976	—	4.8163	—

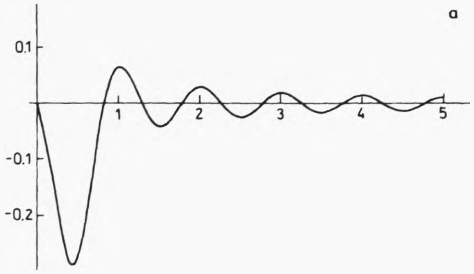

Fig. 1a

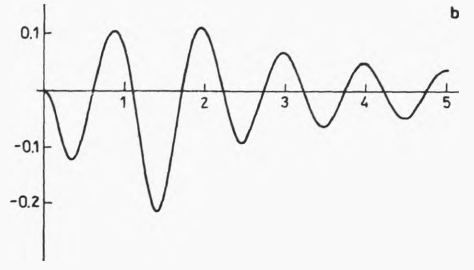

Fig. 1b

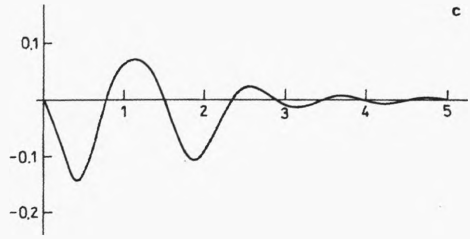

Fig. 1c

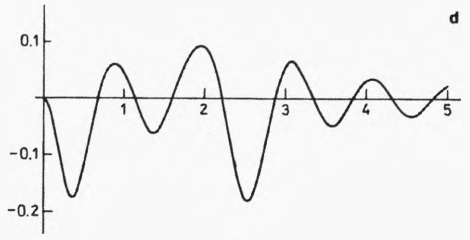

Fig. 1d

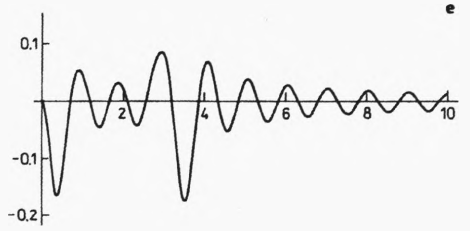

Fig. 1e

Fig. 1. Dependence $\Delta = \left.\dfrac{\partial^2 I(u)}{\partial u^2}\right|_{u=0} = 0(u_{0\,\mathrm{infl}})$ for: **a** – $N = 1$, **b** – $N = 3$, **c** – $N = 5$, **d** – $N = 7$, **e** – $N = 10$

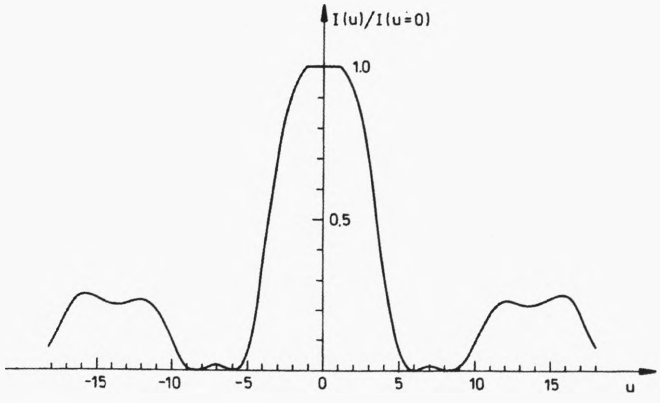

Fig. 2. Normalized intensity distribution $I(u)/I(u=0)$ in the image of the clear slit at the "point of inflexion" $u_{0\,\mathrm{infl}} = 0.667868$ in CSM with $\cos^2[Nx]$ apodizer for $N = 7$

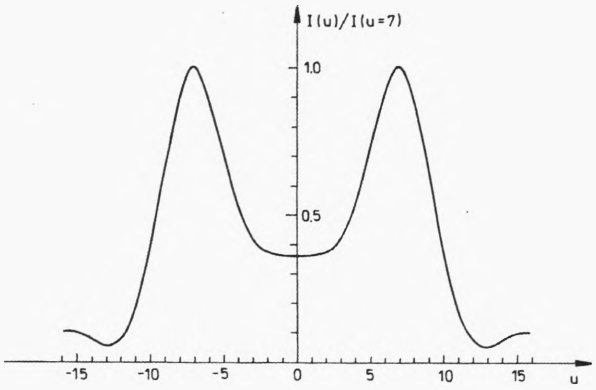

Fig. 3. Normalized intensity distribution $I(u)/I(u=7)$ in the image of the clear slit at the "point of inflexion" $u_{0\,\mathrm{infl}\,3} = 1.5996$ in CSM with $\cos^2[Nx]$ apodizer for $N = 7$

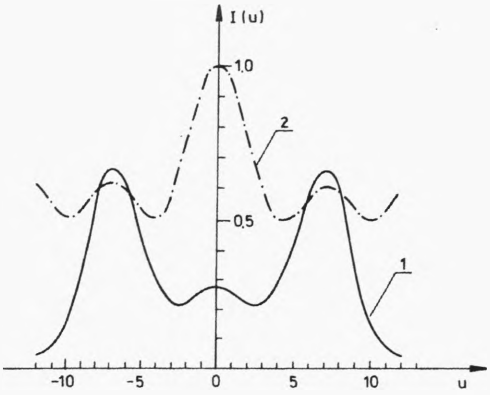

Fig. 4. Distribution of intensity I(u) in the image of clear slit of width $u_0 = 1.5$ (curve 1) and $u_0 = 2.5$ (curve 2) in CSM with $\cos^2[Nx]$ apodizer for $N = 7$

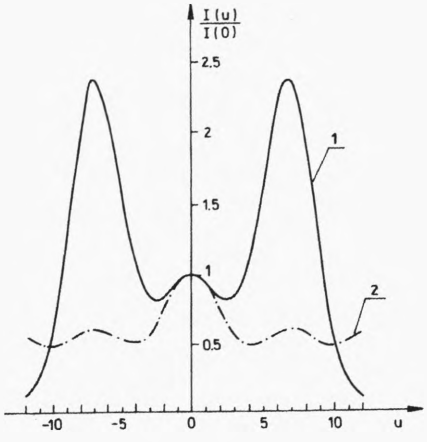

Fig. 5. Normalized intensity distribution $I(u)/I(u=0)$ in the image of the clear aperture of width $u_0 = 1.5$ (curve 1) and $u_0 = 2.5$ (curve 2) in CSM with $\cos^2[Nx]$ apodizer for $N = 7$

References

[1] SURENDAR K., GOUD S. L., DATTA G., MONDAL P. K., Atti Fondaz. Giorgio Ronchi **XLVIII** (1993) 693.

[2] MAGIERA A., Atti Fondaz. Giorgio Ronchi **LI** (1996), 657.

Received July 30, 1996
in revised form December 12, 1996