3.4.9 $N=15$, $d=\lambda/2$, $SL = -20dB, -30dB, -40dB$

a) Dolph-Chebychev

Find roots and weights from:

(i) $R = 10^{(-SL/20)}$

(ii) $x_0 = \cosh\left(\frac{1}{N-1}\cosh^{-1}(R)\right)$ (3.145)

(iii) roots $\varphi_p = 2\cos^{-1}\left(\frac{1}{x_0}\cos\left[(2p-1)\frac{\pi}{2(N-1)}\right]\right)$ (3.154)

$p = 1, 2, \ldots, N-1$

$\Rightarrow z_p = e^{j\varphi_p}$

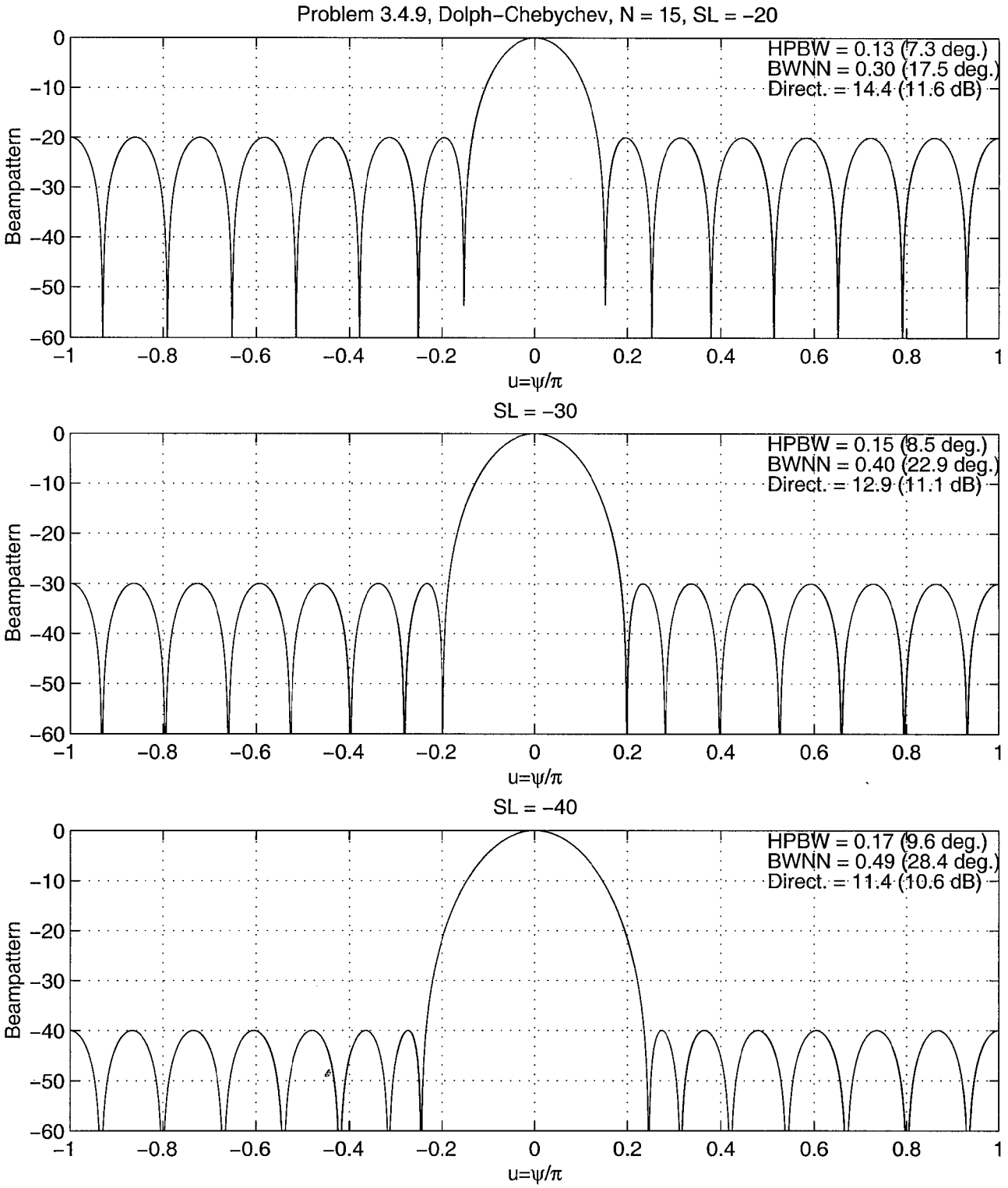
(iv) $w = \text{poly}(z)$

[This works for $N \leq 60$, but Fleun has some numerical difficulties. See problem 3.4.15]

$w =$

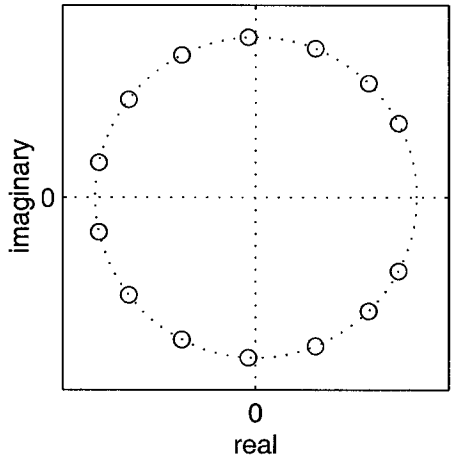
SL=-20	SL=-30	SL=-40
0.0687	0.0290	0.0133
0.0427	0.0336	0.0243
0.0531	0.0489	0.0418
0.0628	0.0649	0.0624
0.0713	0.0799	0.0833
0.0778	0.0921	0.1016
0.0820	0.1002	0.1140
0.0834	0.1030	0.1184
0.0820	0.1002	0.1140
0.0778	0.0921	0.1016
0.0713	0.0799	0.0833
0.0628	0.0649	0.0624
0.0531	0.0489	0.0418
0.0427	0.0336	0.0243
0.0687	0.0290	0.0133

3.4.9 (2)

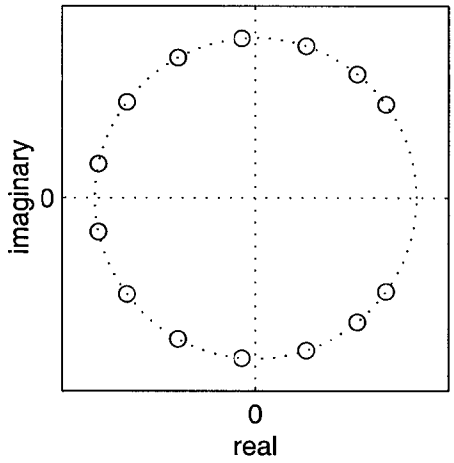

Problem 3.4.9, Dolph-Chebychev, N = 15, SL = -20
HPBW = 0.13 (7.3 deg.)
BWNN = 0.30 (17.5 deg.)
Direct. = 14.4 (11.6 dB)
Beampattern
u=ψ/π
SL = -30
HPBW = 0.15 (8.5 deg.)
BWNN = 0.40 (22.9 deg.)
Direct. = 12.9 (11.1 dB)
Beampattern
u=ψ/π
SL = -40
HPBW = 0.17 (9.6 deg.)
BWNN = 0.49 (28.4 deg.)
Direct. = 11.4 (10.6 dB)
Beampattern
u=ψ/π

3.4.9 ③

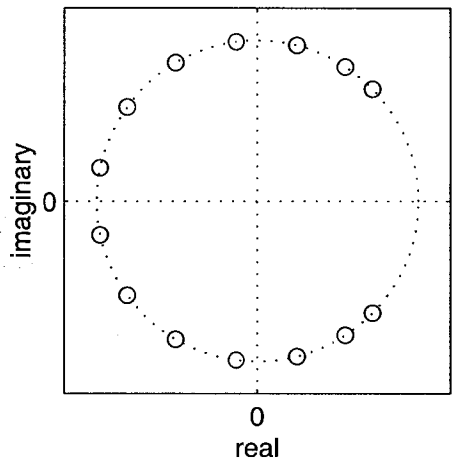
Problem 3.4.9, Dolph–Chebychev, N = 15, SL = –20



SL = –30



SL = –40



3.4.9 (b) Taylor ($\bar{n}=6$), use zero-matching
$N=15$, $d=\lambda/2$, SL = -20 dB, -30 dB, -40 dB

- Find roots and weights from

(i) $R = 10^{(-SL/20)}$

(ii) $A = \frac{1}{\pi}\cosh^{-1}(R)$ (3.175)

(iii) First $\bar{n}-1$ roots given by

- $\varphi_n = \frac{2\pi d}{\lambda} u_n = \frac{2\pi d}{\lambda} \cdot \frac{\lambda}{2d} v_n = \frac{2\pi}{N} v_n$ ($2d = Nd$)

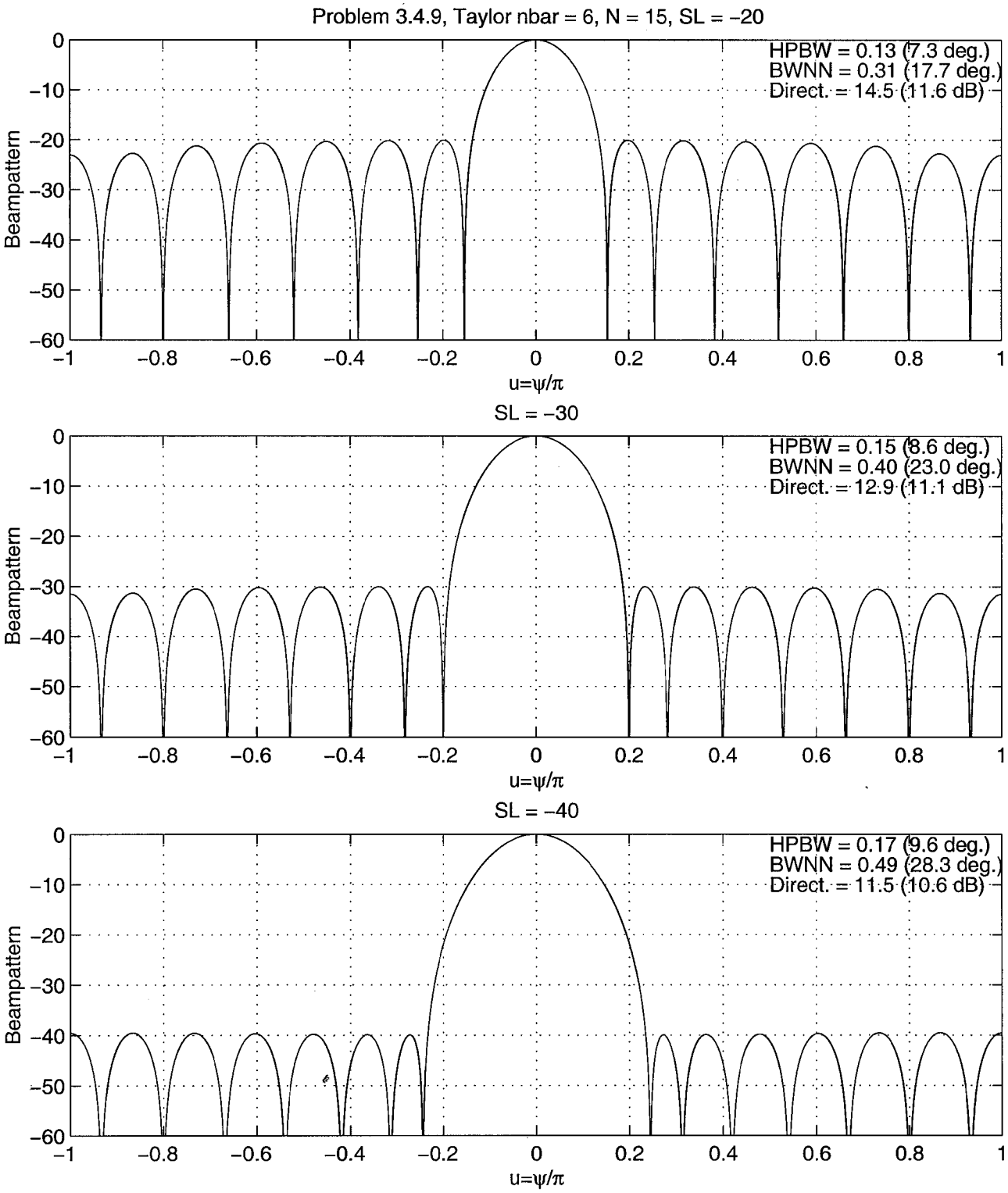
$$= \frac{2\pi \bar{n}}{N}\left[\frac{A^2 + (n-\frac{1}{2})^2}{A^2 + (\bar{n}-\frac{1}{2})^2}\right]^{1/2} \quad n = 1, \ldots, \bar{n}-1 \qquad (3.183)$$

- symmetric roots at $-\varphi_n$, $n = 1, \ldots, \bar{n}-1$
- remaining roots from uniform

(iv) $z_n = e^{j\varphi_n}$; $w = \text{poly}(z)$

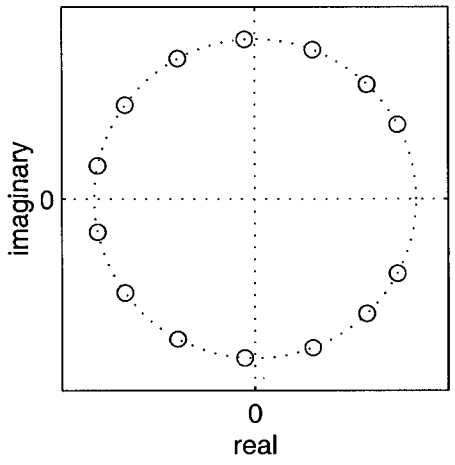
SL=-20	SL=-30	SL=-40
0.0620	0.0277	0.0137
0.0483	0.0343	0.0245
0.0508	0.0483	0.0420
0.0640	0.0651	0.0624
0.0716	0.0800	0.0833
0.0783	0.0924	0.1014
0.0832	0.1006	0.1137
0.0837	0.1033	0.1181
0.0832	0.1006	0.1137
0.0783	0.0924	0.1014
0.0716	0.0800	0.0833
0.0640	0.0651	0.0624
0.0508	0.0483	0.0420
0.0483	0.0343	0.0245
0.0620	0.0277	0.0137

3.4.9 (c)

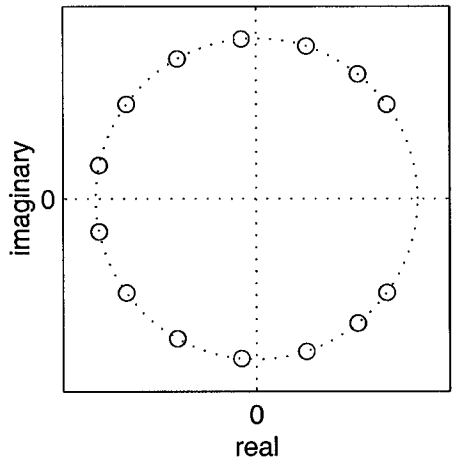

Problem 3.4.9, Taylor nbar = 6, N = 15, SL = –20
HPBW = 0.13 (7.3 deg.)
BWNN = 0.31 (17.7 deg.)
Direct. = 14.5 (11.6 dB)
Beampattern
u=ψ/π
SL = –30
HPBW = 0.15 (8.6 deg.)
BWNN = 0.40 (23.0 deg.)
Direct. = 12.9 (11.1 dB)
Beampattern
u=ψ/π
SL = –40
HPBW = 0.17 (9.6 deg.)
BWNN = 0.49 (28.3 deg.)
Direct. = 11.5 (10.6 dB)
Beampattern
u=ψ/π

3.4.9 (6)

Problem 3.4.9, Taylor nbar = 6, N = 15, SL = −20



SL = −30



SL = −40