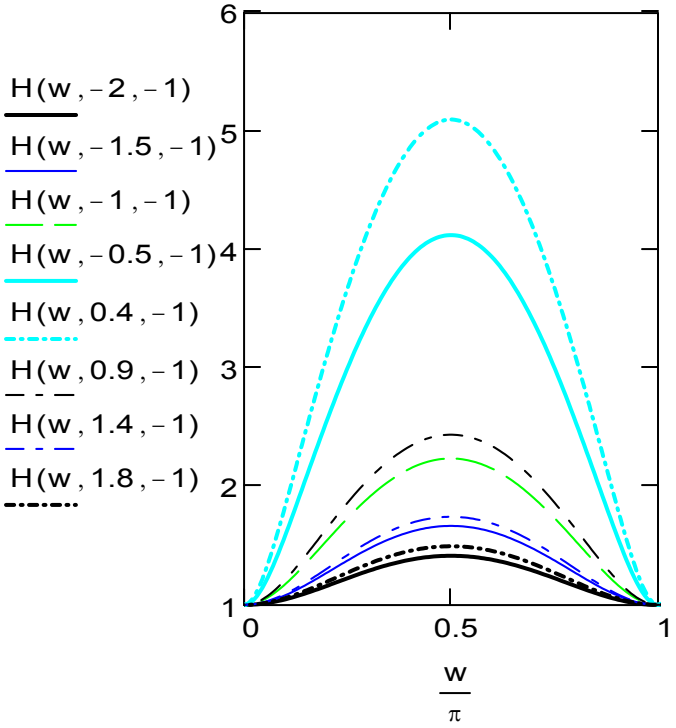
$$H(w, a1, a2) := \frac{\sqrt{a1^2 + (1 - a2)^2 + 2 \cdot a1 \cdot (1 + a2) \cdot \cos(w) + 4 \cdot a2 \cdot \cos(w)^2}}{a2 + 1 + |a1|}$$

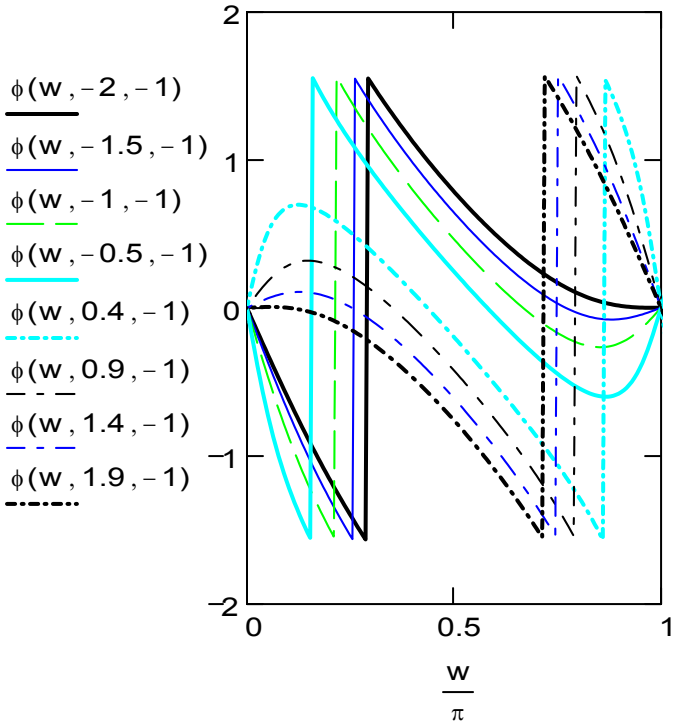
$$\phi(w, a1, a2) := \operatorname{atan}\left[\frac{-(a1 \cdot \sin(w) + a2 \cdot \sin(2w))}{1 + a1 \cdot \cos(w) + a2 \cdot \cos(2w)}\right]$$

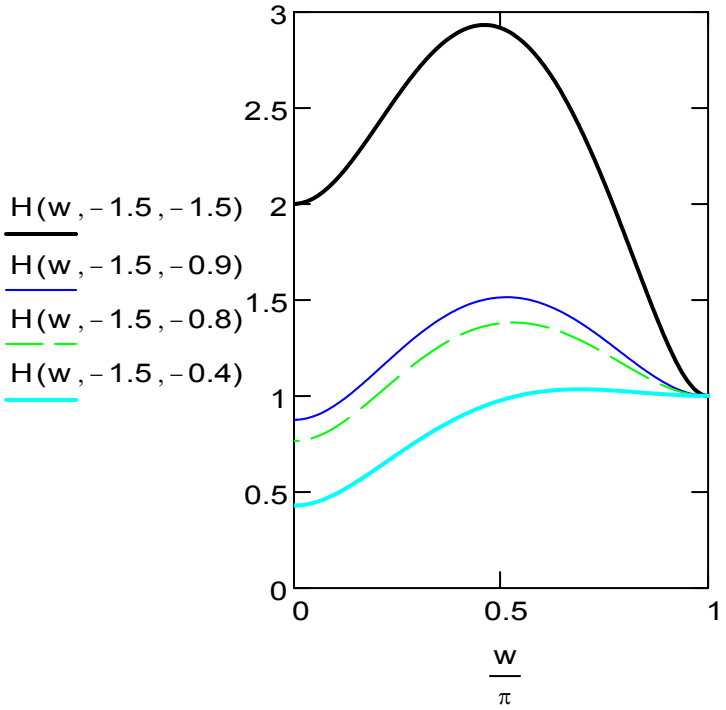
$$z1(a1, a2) := \frac{-a1}{2} + \sqrt{\frac{a1^2}{4} - a2}$$

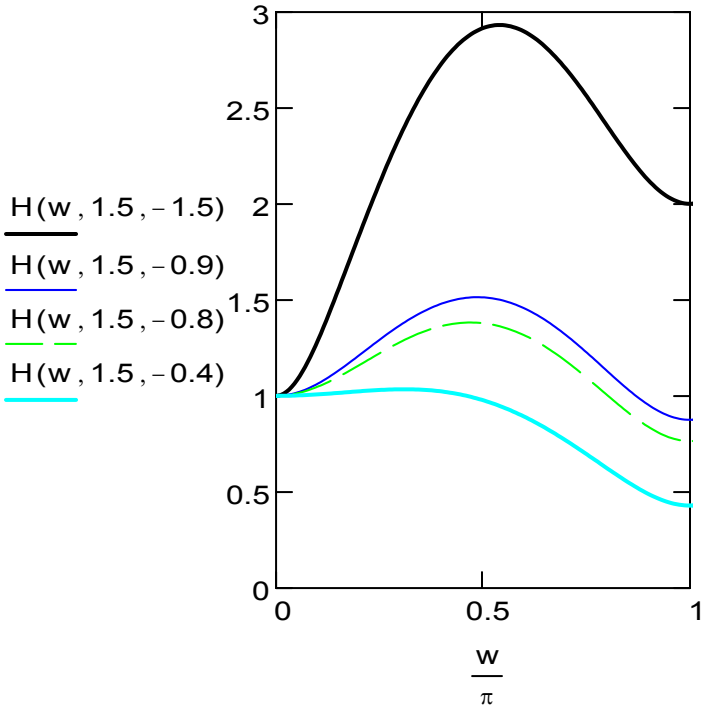
$$z2(a1, a2) := \frac{-a1}{2} - \sqrt{\frac{a1^2}{4} - a2}$$

Полосовой Фильтр









$$wp(a1, a2) := \operatorname{acos}\left(-a1 \cdot \frac{1 + a2}{4a2}\right)$$

$$\frac{wp(-1.5, -1.5)}{\pi} = 0.46 \qquad \frac{wp(1.5, -1.5)}{\pi} = 0.54$$

$$\frac{wp(-1.5, -0.8)}{\pi} = 0.53 \qquad \frac{wp(1.5, -0.8)}{\pi} = 0.47$$

$$\frac{wp(-1.5, -0.4)}{\pi} = 0.69 \qquad \frac{wp(1.5, -0.4)}{\pi} = 0.31$$

$$A(a2) := 4a2 \qquad B(a1, a2) := 2a1 \cdot (1 + a2) \qquad C(a1, a2) := a1^2 + (1 - a2)^2$$

$$b1(a1, a2) := \frac{-B(a1, a2) - \sqrt{\frac{B(a1, a2)^2 - 4 \cdot A(a2) \cdot C(a1, a2)}{2}}}{2A(a2)}$$

$$b2(a1, a2) := \frac{-B(a1, a2) + \sqrt{\frac{B(a1, a2)^2 - 4 \cdot A(a2) \cdot C(a1, a2)}{2}}}{2A(a2)}$$

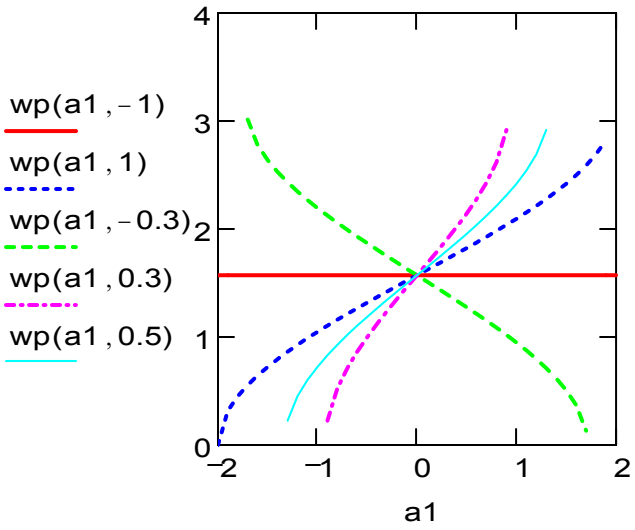
$$w1(a1, a2) := \acos(b1(a1, a2)) \qquad w2(a1, a2) := \acos(b2(a1, a2))$$

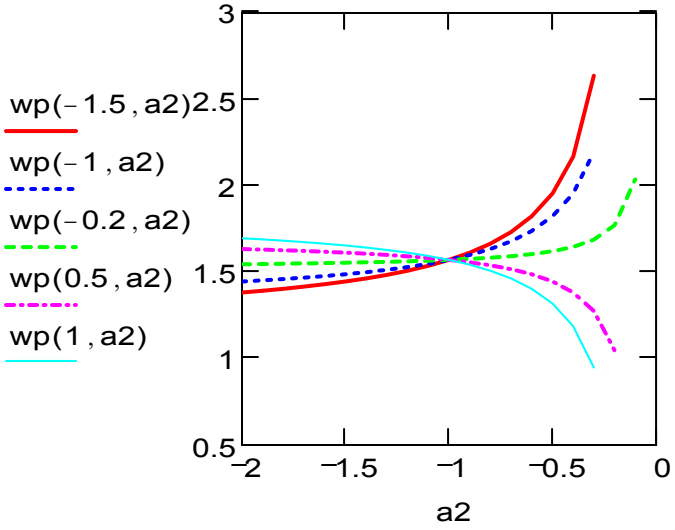
$$Q(a1, a2) := \frac{wp(a1, a2)}{w2(a1, a2) - w1(a1, a2)}$$

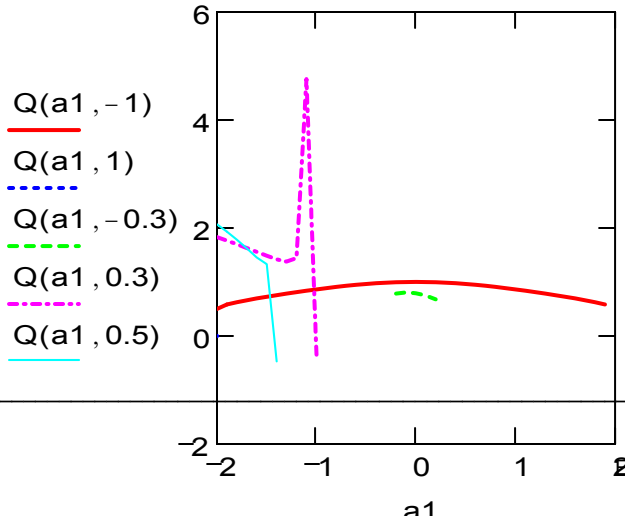
$b1(-1, -1) = 0.791$ $\quad b2(-1, -1) = -0.791$

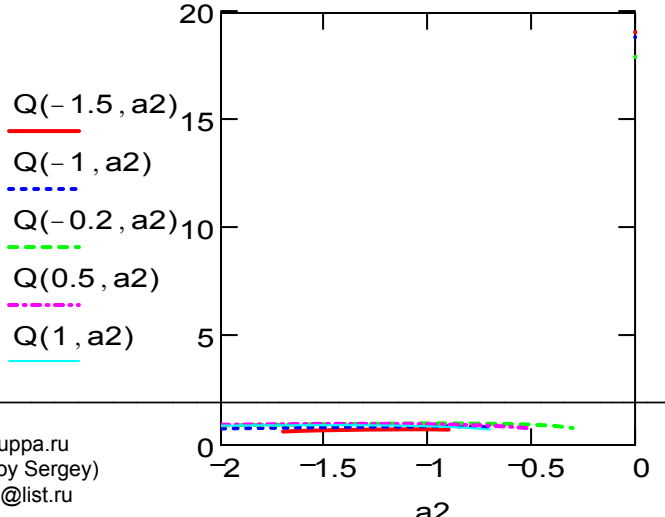
$\frac{w1(-1, -1)}{\pi} = 0.21$ $\quad \frac{w2(-1, -1)}{\pi} = 0.79$ $\quad Q(-1, -1) = 0.861$

$a1 := -2, -1.9 .. 2$ $\qquad a2 := -2, -1.9 .. 0$

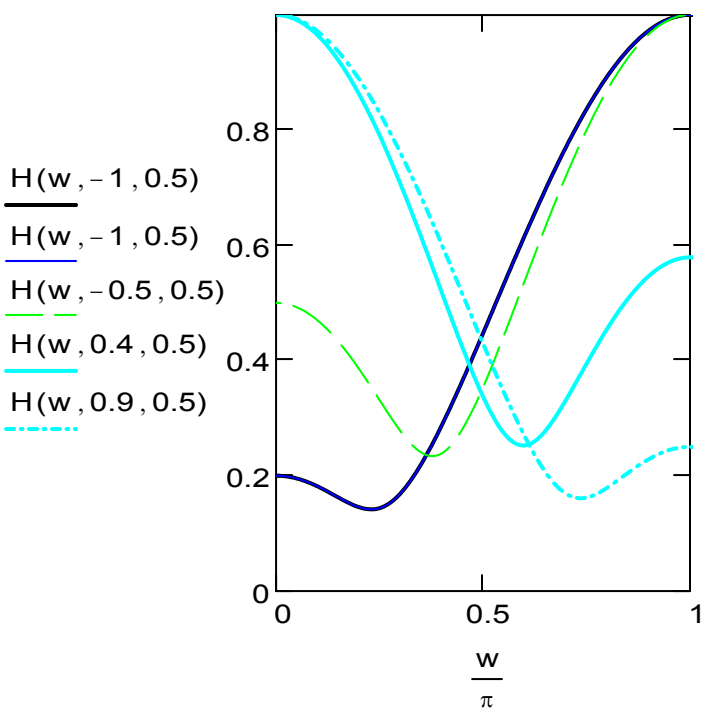


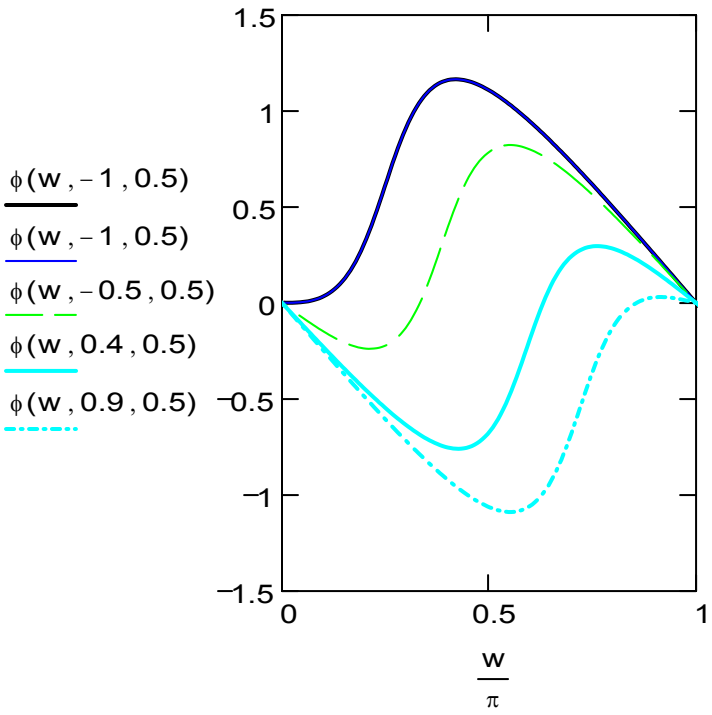


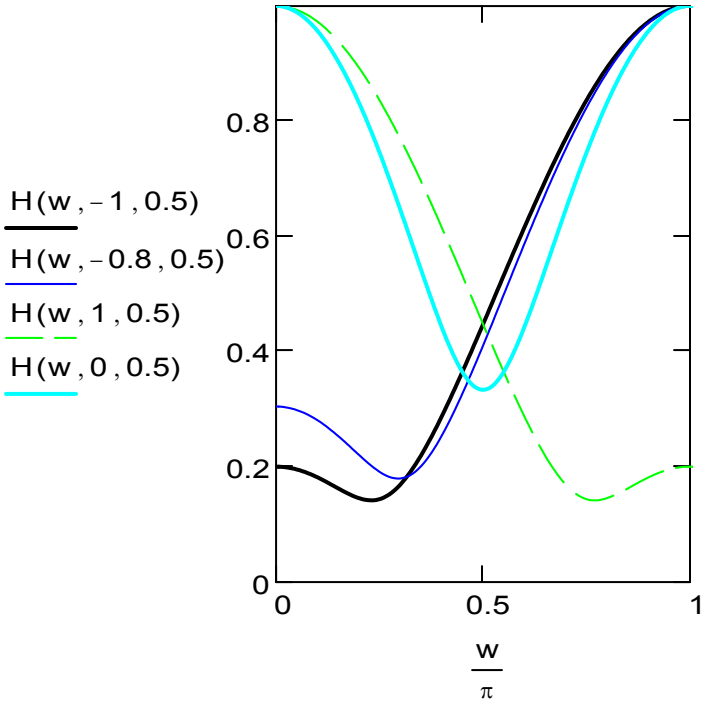


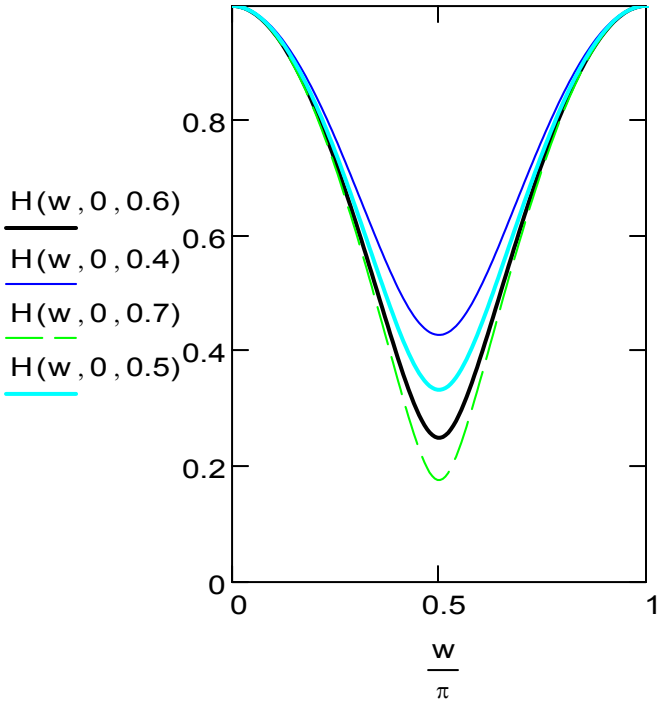


Режекторный фильтр









$$wp(a1, a2) := \operatorname{acos}\left(-a1 \cdot \frac{1 + a2}{4a2}\right)$$

$$\frac{wp(0, 0.5)}{\pi} = 0.5$$

$$\frac{wp(-0.2, 0.5)}{\pi} = 0.452$$

$$\frac{wp(-0.8, 0.5)}{\pi} = 0.295$$

$$\frac{wp(-1.1, 0.5)}{\pi} = 0.191$$

$$\frac{wp(-1, 0.5)}{\pi} = 0.23$$

$$A(a2) := 4a2 \quad B(a1, a2) := 2a1 \cdot (1 + a2) \quad C(a1, a2) := a1^2 + (1 - a2)^2$$

$$b1(a1, a2) := \frac{-B(a1, a2) - \sqrt{B(a1, a2)^2 \cdot (-1) + 4 \cdot A(a2) \cdot C(a1, a2)}}{2A(a2)}$$

$$b2(a1, a2) := \frac{-B(a1, a2) + \sqrt{-B(a1, a2)^2 + 4 \cdot A(a2) \cdot C(a1, a2)}}{2A(a2)}$$

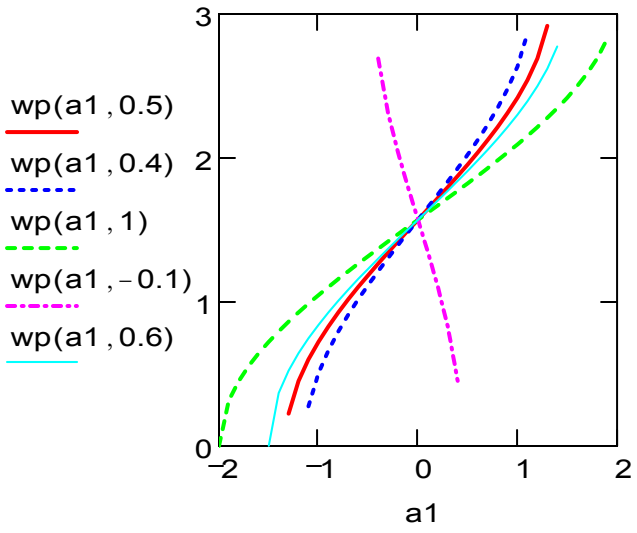
$$w1(a1, a2) := \operatorname{acos}(b1(a1, a2)) \qquad w2(a1, a2) := \operatorname{acos}(b2(a1, a2))$$

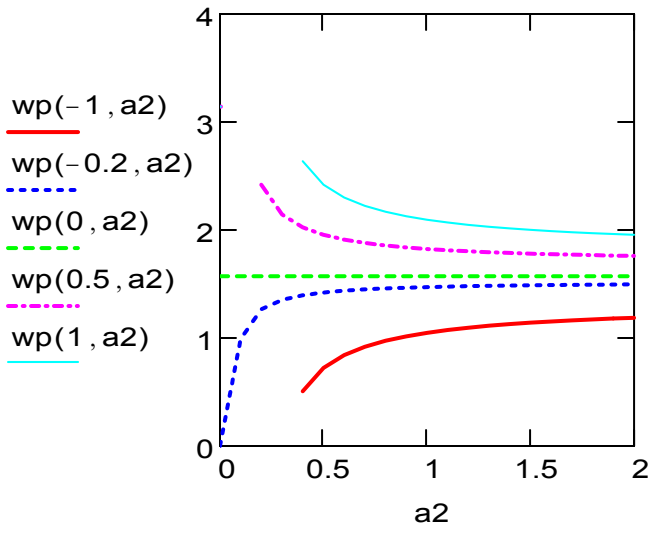
$$Q(a1, a2) := \frac{wp(a1, a2)}{w1(a1, a2) - w2(a1, a2)}$$

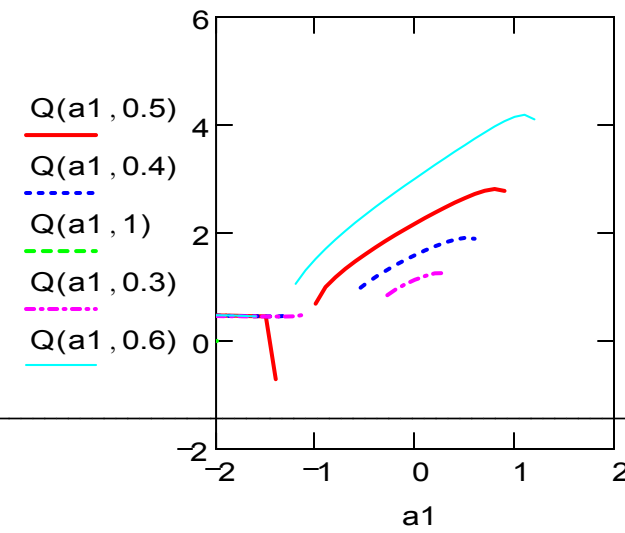
$b1(0, 0.5) = -0.354$ $\quad b2(0, 0.5) = 0.354$

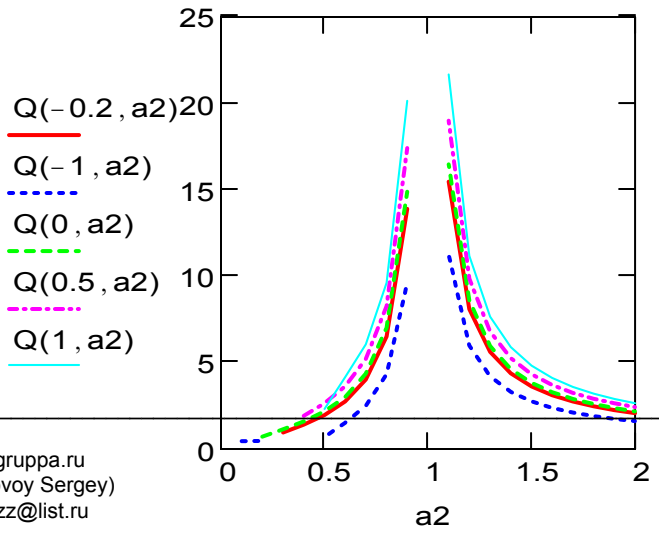
$\frac{w1(0, 0.5)}{\pi} = 0.615$ $\quad \frac{w2(0, 0.5)}{\pi} = 0.385$ $\quad Q(0, 0.5) = 2.173$

$a1 := -2, -1.9 .. 2$ $\quad a2 := 0, 0.1 .. 2$

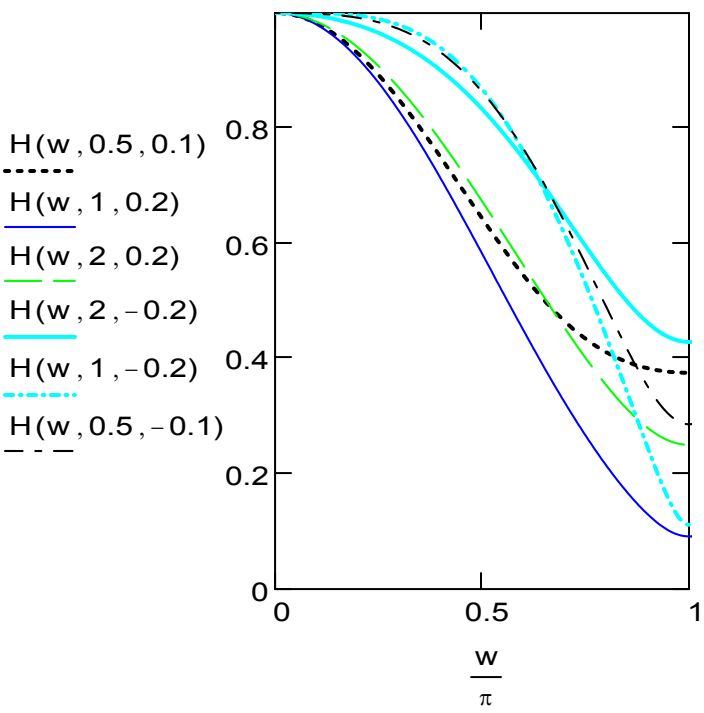


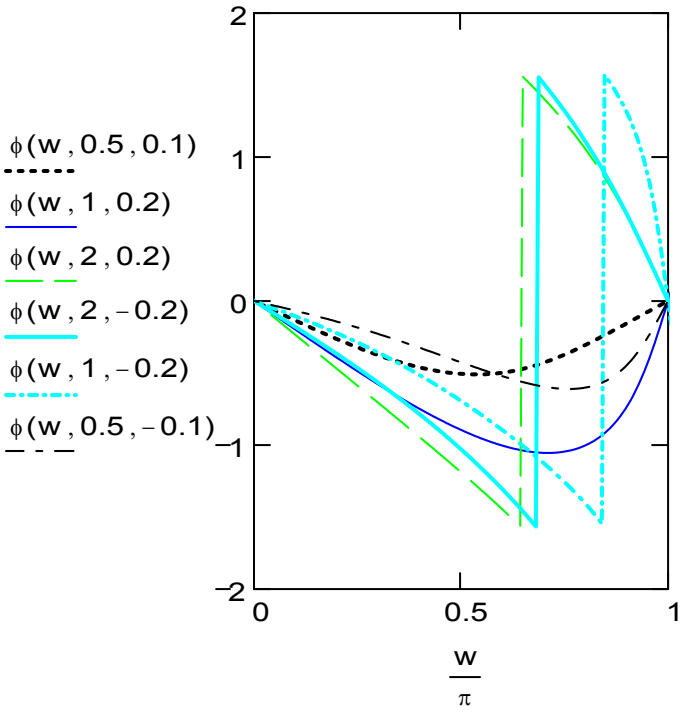






ФНЧ





$$A(a2) := 4a2 \qquad B(a1, a2) := 2a1 \cdot (1 + a2) \qquad C(a1, a2) := a1^2 + (1 - a2)^2$$

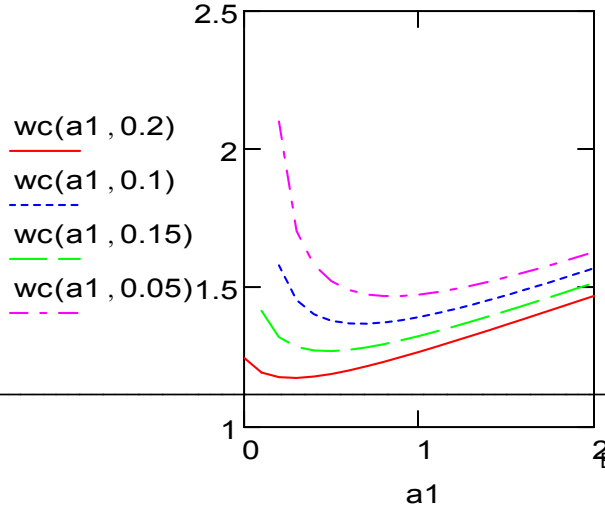
$$wc(a1, a2) := \operatorname{acos}\left[\frac{-B(a1, a2) + \sqrt{B(a1, a2)^2 - 2A(a2)\cdot\left[2C(a1, a2) - (|a1| + a2 + 1)^2\right]}}{2A(a2)}\right]$$

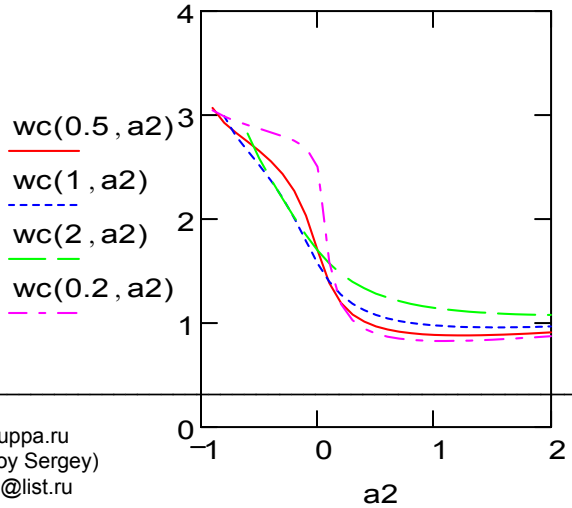
$$\frac{wc(0.5, 0.1)}{\pi} = 0.44 \qquad \frac{wc(2, 0.2)}{\pi} = 0.469 \qquad \frac{wc(1, -0.2)}{\pi} = 0.639$$

$$\frac{wc(1, 0.2)}{\pi} = 0.404 \qquad \frac{wc(2, -0.2)}{\pi} = 0.641 \qquad \frac{wc(0.5, -0.1)}{\pi} = 0.647$$

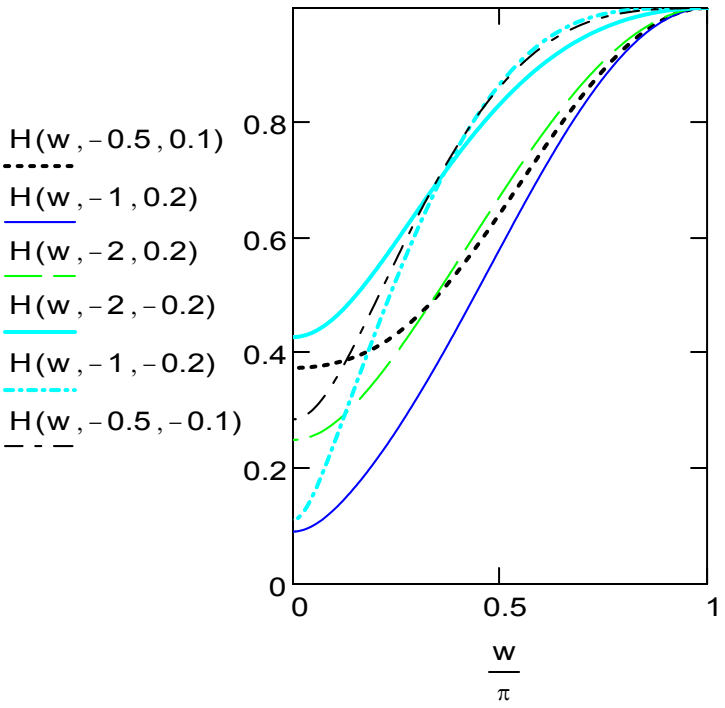
$a1 := 0 , 0.1 .. 2$

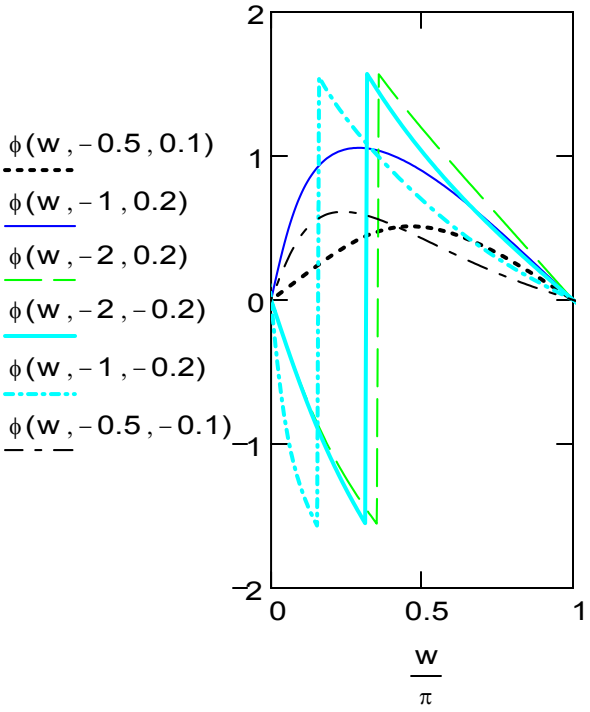
$a2 := -2 , -1.9 .. 2$





ФВЧ





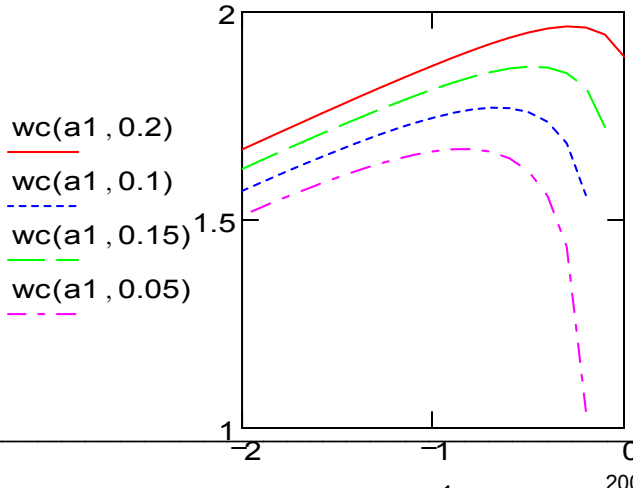
$$wc(a1, a2) := \operatorname{acos}\left[\frac{-B(a1, a2) - \sqrt{B(a1, a2)^2 - 2A(a2)\cdot\left[2C(a1, a2) - (|a1| + a2 + 1)^2\right]}}{2A(a2)}\right]$$

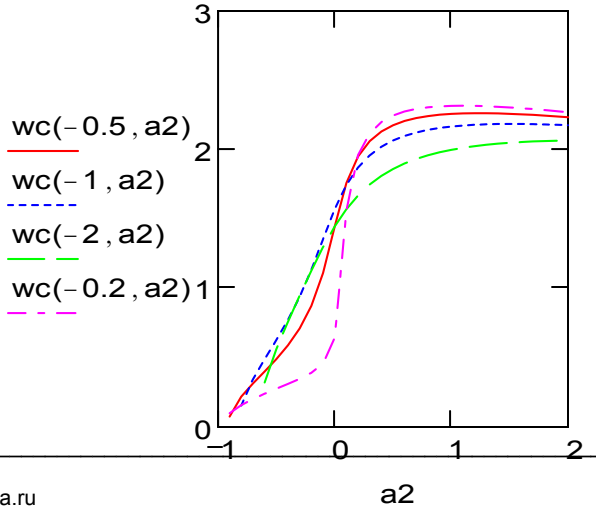
$$\frac{wc(-0.5, 0.1)}{\pi} = 0.56 \qquad \frac{wc(-2, 0.2)}{\pi} = 0.531 \qquad \frac{wc(-1, -0.2)}{\pi} = 0.361$$

$$\frac{wc(-1, 0.2)}{\pi} = 0.596 \qquad \frac{wc(-2, -0.2)}{\pi} = 0.359 \qquad \frac{wc(-0.5, -0.1)}{\pi} = 0.353$$

$a1 := 0, -0.1 .. -2$

$a2 := -2, -1.9 .. 2$





2 Временные характеристики

$$\delta(n) := \begin{cases} 1 & \text{if } n = 0 \\ 0 & \text{otherwise} \end{cases} \qquad one(n) := \begin{cases} 1 & \text{if } n \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

$$h(n, a1, a2) := \delta(n) + a1 \cdot \delta(n-1) + a2 \cdot \delta(n-2) \qquad g(n, a1, a2) := one(n) + a1 \cdot one(n-1) + a2 \cdot one(n-2)$$

$$rect(n, ni) := one(n) - one(n - ni)$$

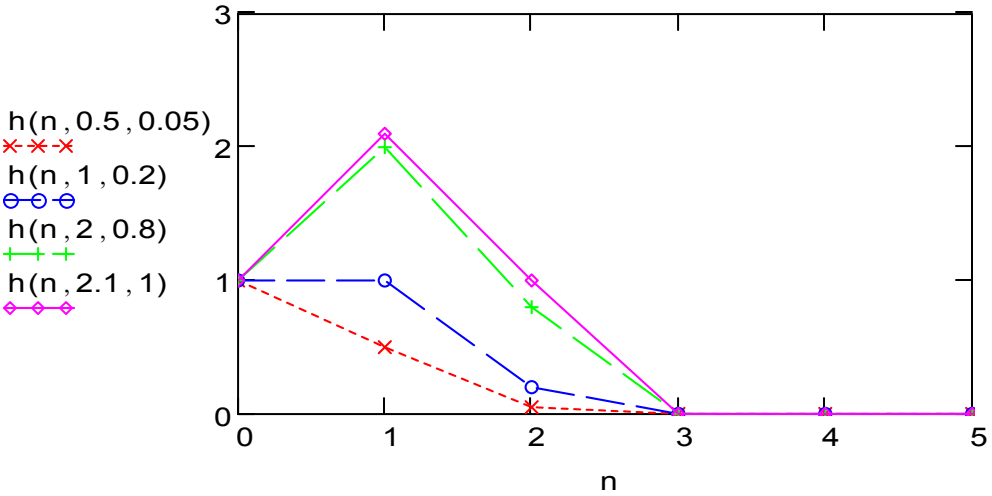
$$RR(n, w, ni) := \sin(w \cdot n) \cdot (one(n) - one(n - ni))$$

$$opr(a1, a2) := \begin{cases} m \leftarrow 0 \\ \text{while } |h(m, a1, a2)| > 0.1 \\ \quad m \leftarrow m + 1 \\ opr \leftarrow m \end{cases}$$

$$n := 0 .. 10$$

2.1 ФНЧ

2.1.1 Импульсная и переходная характеристики

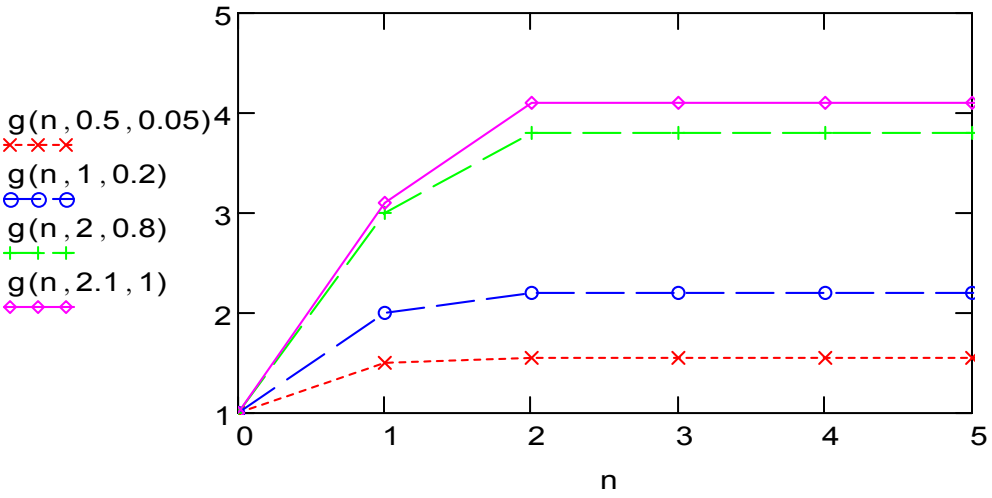


$opr(0.5, 0.05) = 2$

$opr(1, 0.2) = 3$

$opr(2, 0.8) = 3$

$opr(2.1, 1) = 3$



$$opr\_G(a1, a2) := \begin{cases} m \leftarrow 0 \\ \text{while } (1 + a1 + a2) - |g(m, a1, a2)| > 0.1 \\ \quad m \leftarrow m + 1 \\ opr \leftarrow m \end{cases}$$

$opr\_G(0.5, 0.05) = 1$

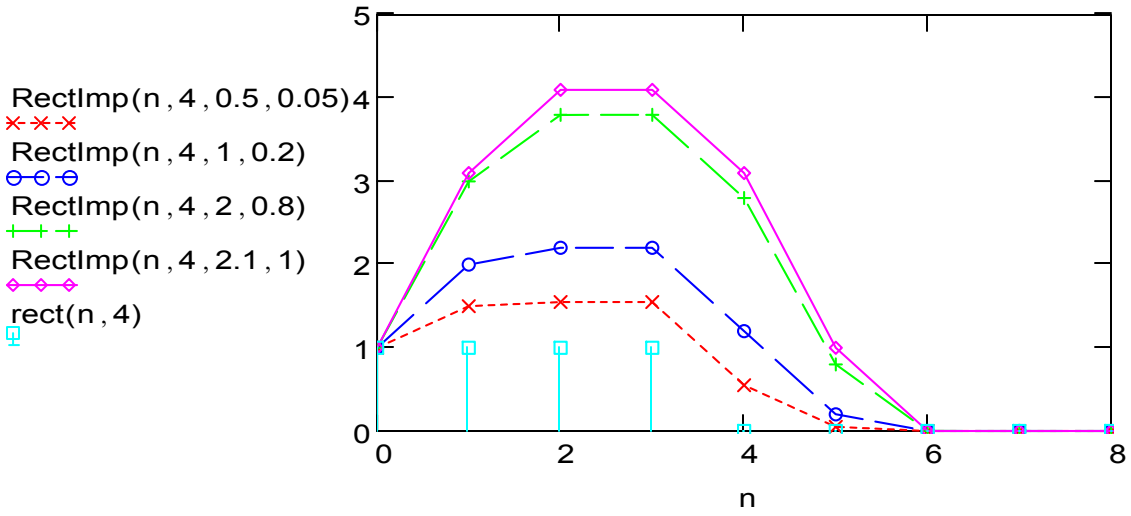
$opr\_G(1, 0.2) = 2$

$opr\_G(2, 0.8) = 2$

$opr\_G(2.1, 1) = 2$

2 , 2 Воздействие на прямоугольный импульс

$$RectImp(n, ni, a1, a2) := rect(n, ni) + a1 \cdot rect(n - 1, ni) + a2 \cdot rect(n - 2, ni)$$



$$\tau\phi(ni, a1, a2) := \left| \begin{array}{l} m \leftarrow 0 \\ \text{while} \quad (1 + a1 + a2) - |RectImp(m, ni, a1, a2)| > 0.1 \\ \quad m \leftarrow m + 1 \\ opr \leftarrow m \end{array} \right.$$

$\tau\phi(4 , 0.5 , 0.05) = 1$

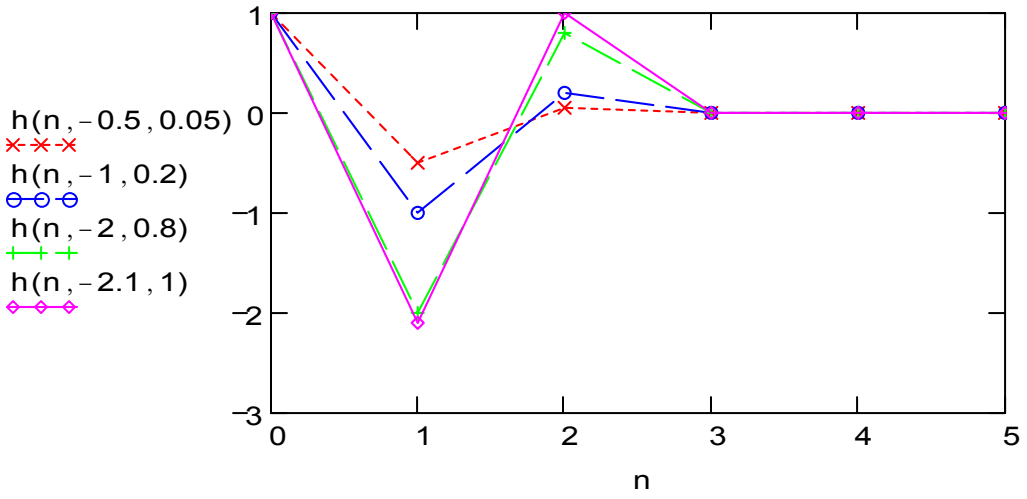
$\tau\phi(4 , 1 , 0.2) = 2$

$\tau\phi(4 , 2 , 0.8) = 2$

$\tau\phi(4 , 2.1 , 1) = 2$

2 , 2 ФВЧ

2.1.1 Импульсная и переходная характеристики

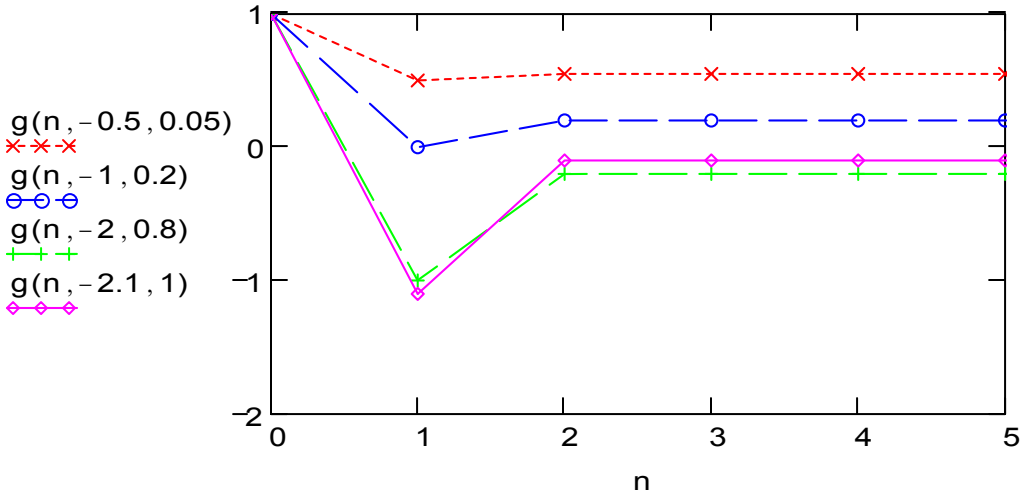


opr(−0.5 , 0.05) = 2

opr(−1 , 0.2) = 3

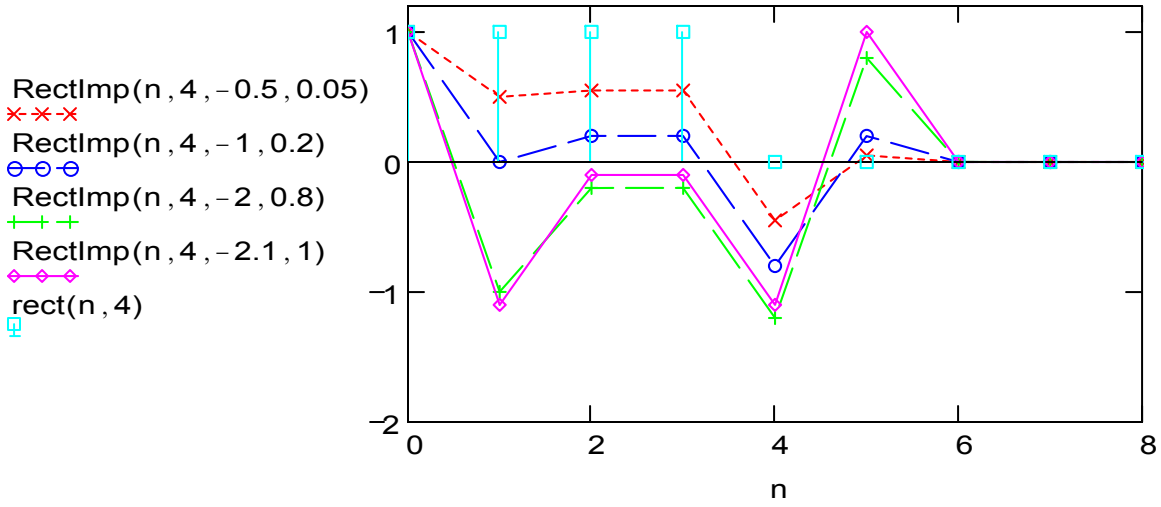
opr(−2 , 0.8) = 3

opr(−2.1 , 1) = 3



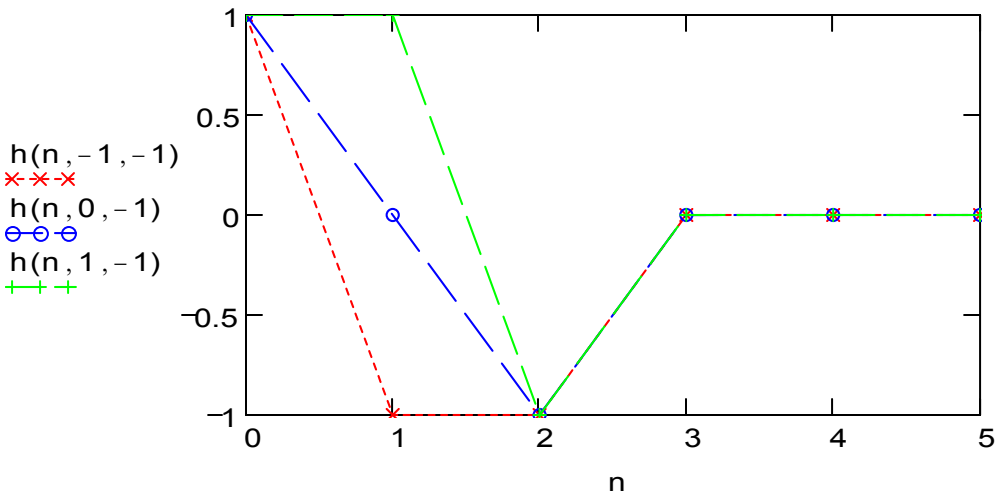
2 , 2 Воздействие на прямоугольный импульс

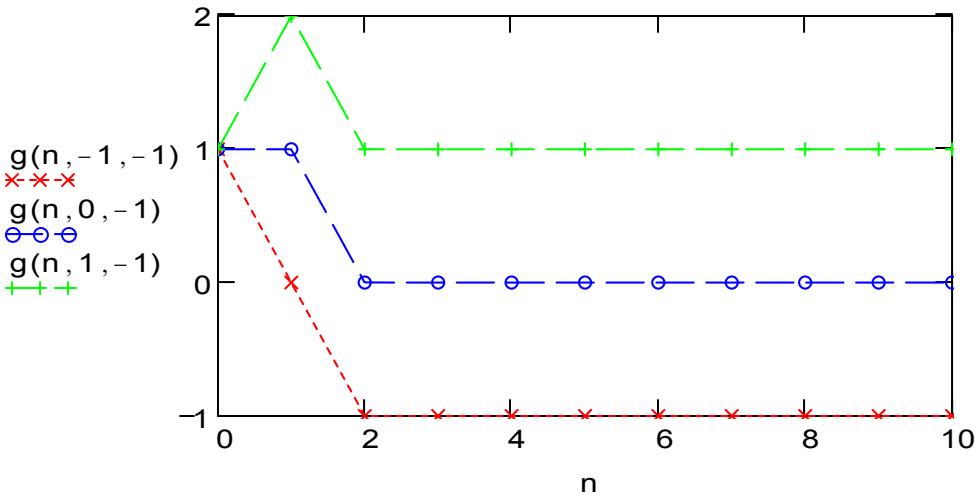
$$RectImp(n , ni , a1 , a2) := rect(n , ni) + a1 \cdot rect(n - 1 , ni) + a2 \cdot rect(n - 2 , ni)$$



Полосовой Фильтр

2.1.1 Импульсная и переходная характеристики

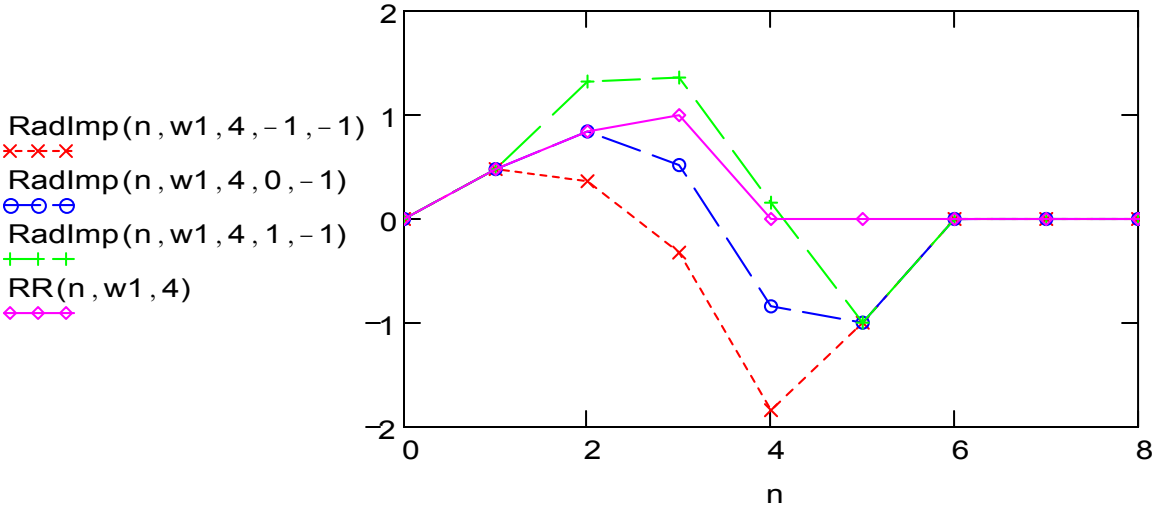




2 , 2 Воздействие на прямоугольный radioимпульс

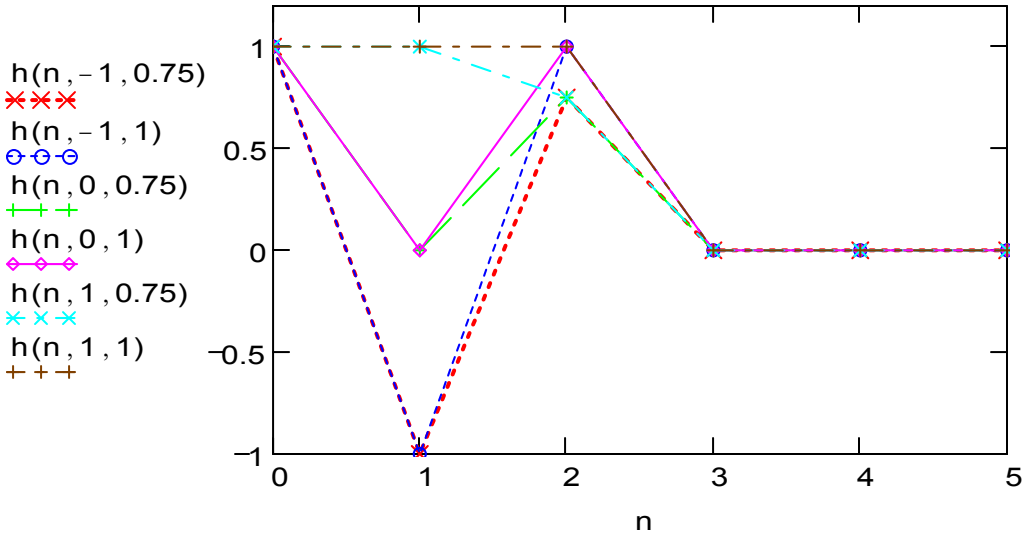
$$w1 := \frac{wp(-1 , -1)}{\pi}$$

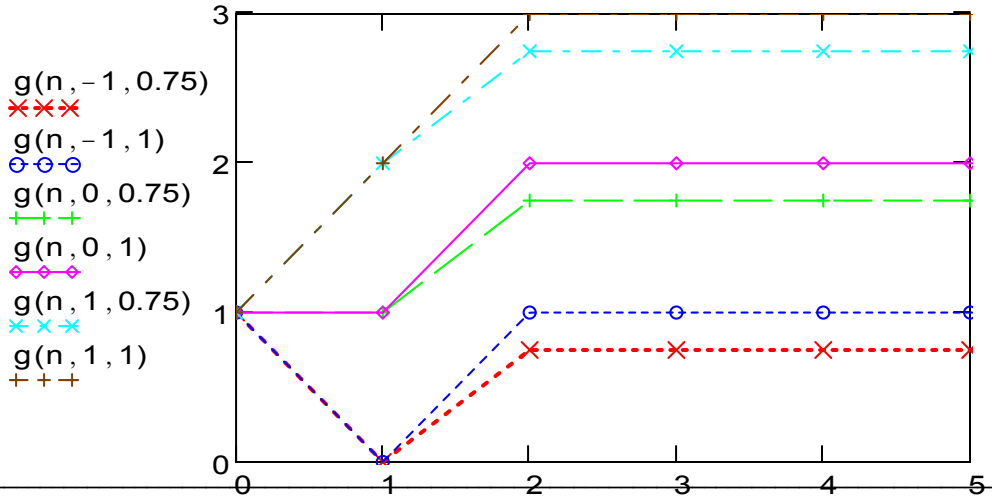
$$RadImp(n , ww , ni , a1 , a2) := RR(n , ww , ni) + a1 \cdot RR(n - 1 , ww , ni) + a2 \cdot RR(n - 2 , ww , ni)$$



Режекторный Фильтр

2.1.1 Импульсная и переходная характеристики





2 , 2 Воздействие на прямоугольный radioимпульс

$$w1 := \frac{wp(-1 , 1)}{\pi} \qquad w1 = 0.333$$

$$RadImp(n , ww , ni , a1 , a2) := RR(n , ww , ni) + a1 \cdot RR(n - 1 , ww , ni) + a2 \cdot RR(n - 2 , ww , ni)$$