

Target equation:

$$-ia_1u^{(1,0)}(x,t) + a_2u^{(2,0)}(x,t) - ia_3u^{(3,0)}(x,t) + a_4u^{(4,0)}(x,t) - ia_5u^{(5,0)}(x,t) + a_6u^{(6,0)}(x,t) - ia_7u^{(7,0)}(x,t) + a_8u^{(8,0)}(x,t) - bu(x,t)|u(x,t)|^2 + iu^{(0,1)}(x,t) = 0$$

Substitutions:

$$N = 4$$

$$u(x,t) \rightarrow y(z)e^{i(kx-\omega t)}$$

$$z \rightarrow x - C_0t$$

$$y(z) \rightarrow AR(z)^4$$

$$R'(z)^2 = R(z)^2(1 - \chi R(z)^2)$$

Imaginary part of equation after substitutions:

$$y'(z)(a_1 - 2a_2k - 3a_3k^2 + 4a_4k^3 + 5a_5k^4 - 6a_6k^5 - 7a_7k^6 + 8a_8k^7 - C_0) + y^{(3)}(z)(a_3 - 4a_4k - 10a_5k^2 + 20a_6k^3 - 15a_7k^4 + 6a_8k^5) + y^{(5)}(z)(a_5 - 4a_6k - 10a_7k^2 + 6a_8k^3) - 6a_6ky^{(5)}(z) - 21a_7k^2y^{(5)}(z) + a_7y^{(7)}(z) + 56a_8k^3y^{(5)}(z) - 8a_8ky^{(7)}(z) = 0$$

Real part of equation after substitutions:

$$y(z)(a_1k - a_2k^2 - a_3k^3 + a_4k^4 + a_5k^5 - a_6k^6 - a_7k^7 + a_8k^8 + \omega) + y''(z)(a_2 + 3a_3k - 6a_4k^2 - 10a_5k^3 + 15a_6k^4 - 6a_7k^5 + 3a_8k^6) + y^{(4)}(z)(a_4 + 4a_5k - 6a_6k^2 + 4a_7k^3 - 2a_8k^4) + 5a_5ky^{(4)}(z) - 15a_6k^2y^{(4)}(z) + a_6y^{(6)}(z) - 35a_7k^3y^{(4)}(z) + 7a_7ky^{(6)}(z) + 70a_8k^4y^{(4)}(z) - 28a_8k^2y^{(6)}(z) + a_8y^{(8)}(z) - by(z)^3 = 0$$

Constraints on coefficients from imaginary part of equation:

$$a_7 \rightarrow 8a_8k$$

$$a_5 \rightarrow 2(3a_6k + 56a_8k^3)$$

$$a_3 \rightarrow 4(a_4k + 10a_6k^3 + 224a_8k^5)$$

$$C_0 \rightarrow a_1 - 2a_2k - 8a_4k^3 - 96a_6k^5 - 2176a_8k^7$$

Constraints on coefficients from real part of equation:

$$b \rightarrow \frac{6652800a_8\chi^4}{A^2}$$

$$a_6 \rightarrow -4a_8(7k^2 + 54)$$

$$a_4 \rightarrow 2(35a_8k^4 + 1620a_8k^2 + 7752a_8)$$

$$a_2 \rightarrow -4(7a_8k^6 + 810a_8k^4 + 23256a_8k^2 + 106816a_8)$$

$$\omega \rightarrow -a_1k - 7a_8k^8 - 1080a_8k^6 - 46512a_8k^4 - 427264a_8k^2 + 3686400a_8$$

y(z) - function:

$$\frac{256a^4A}{(4a^2e^z + \chi e^{-z})^4}$$

u(x, t) - function:

$$\frac{256a^4Ae^{i(kx-\omega t)}}{(4a^2e^{C_0t+x} + \chi e^{-C_0t-x})^4}$$