The homogeneous Helmholtz equation is given by

|  |  |  |
| --- | --- | --- |
|  | . | (1) |

By considering a solution of the form

|  |  |  |
| --- | --- | --- |
|  | , | (2) |

where is the amplitude and is the travel-time one obtains the following two coupled equations

|  |  |  |
| --- | --- | --- |
|  | , | (3) |

|  |  |  |
| --- | --- | --- |
|  | , | (4) |

, is the directional derivative of along the direction of . Therefore, equation (4) is an ordinary differential equation:

Where

We reorganize equation (4) into

|  |  |  |
| --- | --- | --- |
|  | , | (5) |

We now define

=>

and

So that equations (4) and (5) become

|  |  |  |
| --- | --- | --- |
|  | , | (6) |

|  |  |  |
| --- | --- | --- |
|  | . | (7) |

We now write equation (7) in its explicit 2 dimensional coordinates

|  |  |  |
| --- | --- | --- |
|  | . | (8) |

;

So equation (8) becomes

|  |  |  |
| --- | --- | --- |
|  | . | (8) |