1. **Boundary Conditions at the Source**

The first differential equation describing the voltage and current on the transmission line is:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Approximating the derivatives with finite differences yields:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Where n is the index of time (t) and m is the index of space (z). Now let for the beginning of the transmission line:

|  |  |  |
| --- | --- | --- |
|  |  |  |

KVL at the source yields the boundary condition:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Plugging (4) into (3) yields:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Solving for …

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| --- | --- | --- |
|  |  |  |

|  |  |  |
| --- | --- | --- |
|  |  |  |

Looking at equation (7), note that for any time *n*, the current at node 1 is calculated based on the previous current in time, the adjacent voltage in space, and the voltage of the source.

The second differential equation is:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Approximating the derivatives with finite differences yields:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Where n is the index of time (t) and m is the index of space (z). Now let for the beginning of the transmission line:

|  |  |  |
| --- | --- | --- |
|  |  |  |

KVL at the source yields the boundary condition:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Substituting (11) into (10) yields:

|  |  |  |
| --- | --- | --- |
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Solving for …

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| --- | --- | --- |
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Looking at equation (15), note that for any time *n*, the voltage at node 1 is calculated based on the previous voltage in time, the adjacent current in space, and the value of the source.

1. **Boundary Conditions at the Termination**

Equation (2) can be rewritten with a backward difference:

|  |  |  |
| --- | --- | --- |
|  |  |  |

For the termination, let :

|  |  |  |
| --- | --- | --- |
|  |  |  |

Ohm’s Law at the termination yields the boundary condition:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Substituting (18) into (17) yields:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Solving for …

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| --- | --- | --- |
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Similarly, equation (9) can be rewritten as a backward difference:

|  |  |  |
| --- | --- | --- |
|  |  |  |

For the termination, let :

|  |  |  |
| --- | --- | --- |
|  |  |  |

Ohm’s Law at the termination yields the boundary condition:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Substituting (24) into (23) yields:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Solving for …

|  |  |  |
| --- | --- | --- |
|  |  |  |

|  |  |  |
| --- | --- | --- |
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|  |  |  |