



Pole-Residue in Touchstone

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Agenda

- **Document overview**
- **File formats**
- **Pole-Residue Format details**
- **Examples**
- **File options**
- **Some formatting issues**
- **Other details**
- **Conclusions**

Planned Touchstone 3.0 Content

- **Keep existing Touchstone 1.1 and 2.0 Matrix Formats (S-, Y-, Z-, H-, G-parameters)**
- **Add some corrections or advances**
- **Pole-Residue Format (functionally similar to IBIS-ISS and HSPICE Foster controlled sources)**
 - **Optional Delay parameter**
 - **Optional Asymptote parameter for Y-, Z-parameters**
 - **Optional Residue_at_Infinity parameter**
- **Port mapping proposal (being discussed)**

Pole-Residue Format Details

- **Independent poles and residues per port**
- **Common poles and independent residues per port**
- **For real poles and residues – imaginary parts are set to 0.0**
- **For complex poles, the complex conjugates are assumed to be identical, therefore**
 - **Complex poles – only one real part listed**
 - **Complex residue – one imaginary part is listed**
- **Four numbers per line:**
 - **<Re{pole}> <Im{pole}> <Re{residue}> <Im{residue}>**
 - **[Number of Poles] = real_poles + 2 * complex_pole_lines**
- **Delay parameter available for independent poles only**

Independent Pole Format Example

```
[Begin Pole/Residue Data] (1,1)
Delay                1.26351e-09
Asymptote            0.83754e-12
Residue_at_Infinity  0.321123423421
Number_of_Poles      35
  1.60981891306855e+08  6.03830005978569e+09 -2.15363238798792e-06  1.96534688582861e-05
  2.93321810887676e+09  1.91770843721616e+09 -1.05426912887832e+01 -8.82630433918342e+00
  1.23990373548953e+08  4.39994357143840e+09  1.25728612812034e-05  2.13669372820529e-05
  1.57193681614524e+08  3.10437931944199e+09  5.10972708034658e-05 -1.15663907003945e-05
  2.83363448768380e+07  2.10218276754607e+09  3.07314704488451e-06  5.16091015967049e-06
  ...
  5.23409852743859e+06  1.34534534593845e+07  3.07314704488451e-06  5.16091015967049e-06
[End Pole/Residue Data]
```

[Begin Pole/Residue Data] / [End Pole/Residue Data] section repeated for (1,2),
..., (1,p), ..., (p,1), ..., (p,p)
where p is the number of ports

Common Pole Format Example

[Begin Common Poles Data]

Number_of_Poles	35
1.60981891306855e+08	6.03830005978569e+09
2.93321810887676e+09	1.91770843721616e+09
1.23990373548953e+08	4.39994357143840e+09
1.57193681614524e+08	3.10437931944199e+09
2.83363448768380e+07	2.10218276754607e+09
...	
5.23409852743859e+06	1.34534534593845e+07

[End Common Poles Data]

[Begin Residues Data]	(1,1)
Asymptote	0.83754e-12
Residue_at_Infinity	0.321123423421
Number_of_Residues	35

-2.15363238798792e-06	1.96534688582861e-05
-1.05426912887832e+01	-8.82630433918342e+00
1.25728612812034e-05	2.13669372820529e-05
5.10972708034658e-05	-1.15663907003945e-05
3.07314704488451e-06	5.16091015967049e-06
...	
3.07314704488451e-06	5.16091015967049e-06

[End Residues Data]

[Begin Residues Data] / [End Residues Data] section repeated for (1,2), ..., (1,p), ..., (p,1), ..., (p,p) where p is the number of ports

Pole-Residue Format Details

- **Permits active-matrix data like Touchstone 2.0**
- **Duplicate poles permitted**
 - **EDA Tool can split the poles**
 - **Split poles compatible with vector fitting and recursive convolution processing**
- **S-, Y-, Z-parameters (dimensionless, Siemens, Ohms)**
- **H-, G- parameters for two-ports?**
- **Supports most Touchstone 2.0 features**
- **Does not support noise parameters**

File Options

- Touchstone file contains Matrix Format only
- Touchstone file contains Pole-Residue Format only
- Touchstone file both Pole-Residue and Matrix Format
 - In this case Pole-Residue data is first in the file
- Optional port mapping section (under development), applicable to both data formats

Issues / Questions to Resolve

- **Prefer keyword-based format like Touchstone 2.0 and IBIS 7.1**
- **What to do with the Options Line (# Data)?**
 - **Single Reference or [Reference] per port**
 - **Support only base units (with scientific notation) for poles and residues or support engineering multipliers (k, M, G, T) for better readability**
- **How to handle 2-port features in Touchstone 2.0?**
 - **[Two-Port Data Order] {12_21 | 21_12}**
- **Should we support H-, G-parameters with Pole-Residue Format?**

Other Comments

- **Does not add new features outside of Touchstone 2.0**
- **Discussions on Pole-Residue and Port Mapping are currently in progress**
- **[Matrix Format] {Full | Upper | Lower} for symmetrical matrices**
- **[Mixed Mode Order] S, C, D for single-ended, common mode and differential representations**
- **Passivity, causality, stability not checked by the Touchstone parser**
 - **Right-hand plane poles permitted**

Questions / Comments?

Thank You!