

Open-Source De-embedding

```

56 % s_side1--an s parameter object of the error box representing the half of
57 % s_side2--an s parameter object of the error box representing the half of
58 %
59 % residual test usage:
60 %
61 % [s_side1,s_side2] = IEEE3702xThru(s_2xthru);
62 % s_deembedded_dut = deembedsparams(s_fixture_dut_fixture,s_side1,s_side2);
63
64 - f = s_2xthru.Frequencies.';
65 - s = s_2xthru.Parameters;
66
67 - n = length(f);
68
69 - s11 = squeeze(s(1,1,:));
70
71 % get e001 and e002
72 % e001
73 - s21 = squeeze(s(2,1,:));
74 - dcs21 = dc_interp(s21,f);
75 - t21 = fftshift(iff(makeSymmetric([dcs21;s21]),'symmetric'));
76 - [~,x] = max(t21);
77
78 - dcs11 = DC(s11,f);
79 - t11 = fftshift(iff(makeSymmetric([dcs11;s11]),'symmetric'));
80 - step11 = makeStep(t11);
81 - z11 = -50.*(step11 + 1)./(step11 - 1);
82 - z11x = z11(x);
83
84 - temp = sparameters(s,f,50);
85 - temp = sparameters(temp,z11x);
86 - sr = temp.Parameters;
87 - clear temp;
88
89 - s11r = squeeze(sr(1,1,:));
90 - s21r = squeeze(sr(2,1,:));
91 - s12r = squeeze(sr(1,2,:));

```

Agenda

MOTIVATION

QUICK OVERVIEW OF DE-EMBEDDING

WHERE DO I FIND THE CODE?

HOW DO I USE THE CODE?

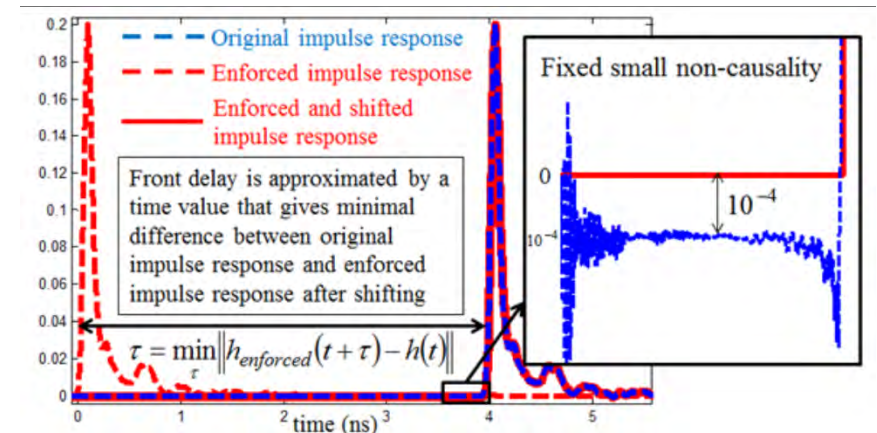
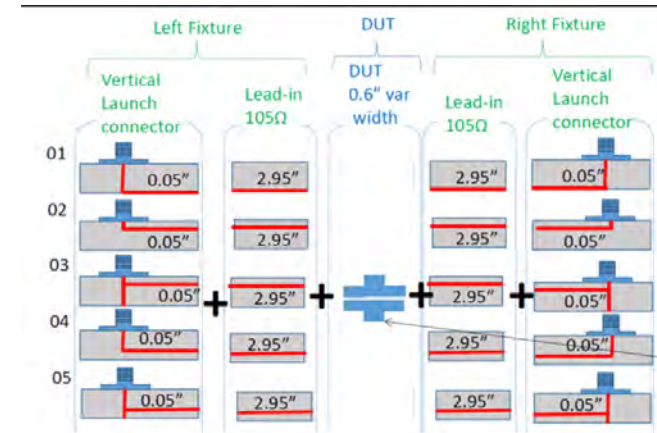
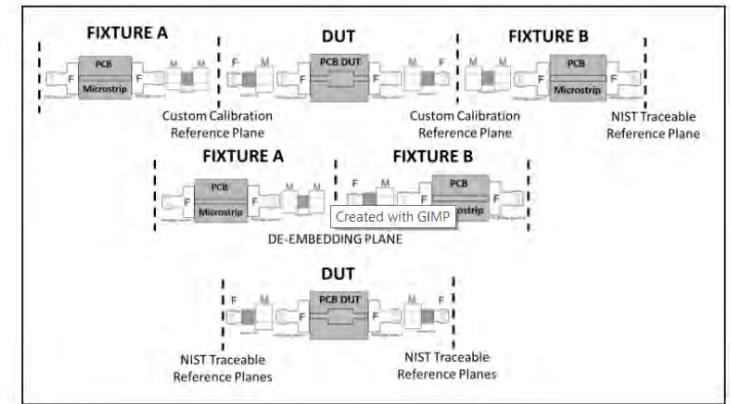
HOW MUCH DOES IT COST?

FUTURE ENHANCEMENTS

HOW CAN I CONTRIBUTE TO THE ALGORITHM?

Motivation

IEEE 370-2020 - IEEE Standard for Electrical Characterization of Printed Circuit Board and Related Interconnects at Frequencies up to 50 GHz



Quick Overview of De-embedding

FIXTURE-DUT-FIXTURE

$(\text{FIXTURE MODEL})^{-1}$
CALIBRATION PLANE A

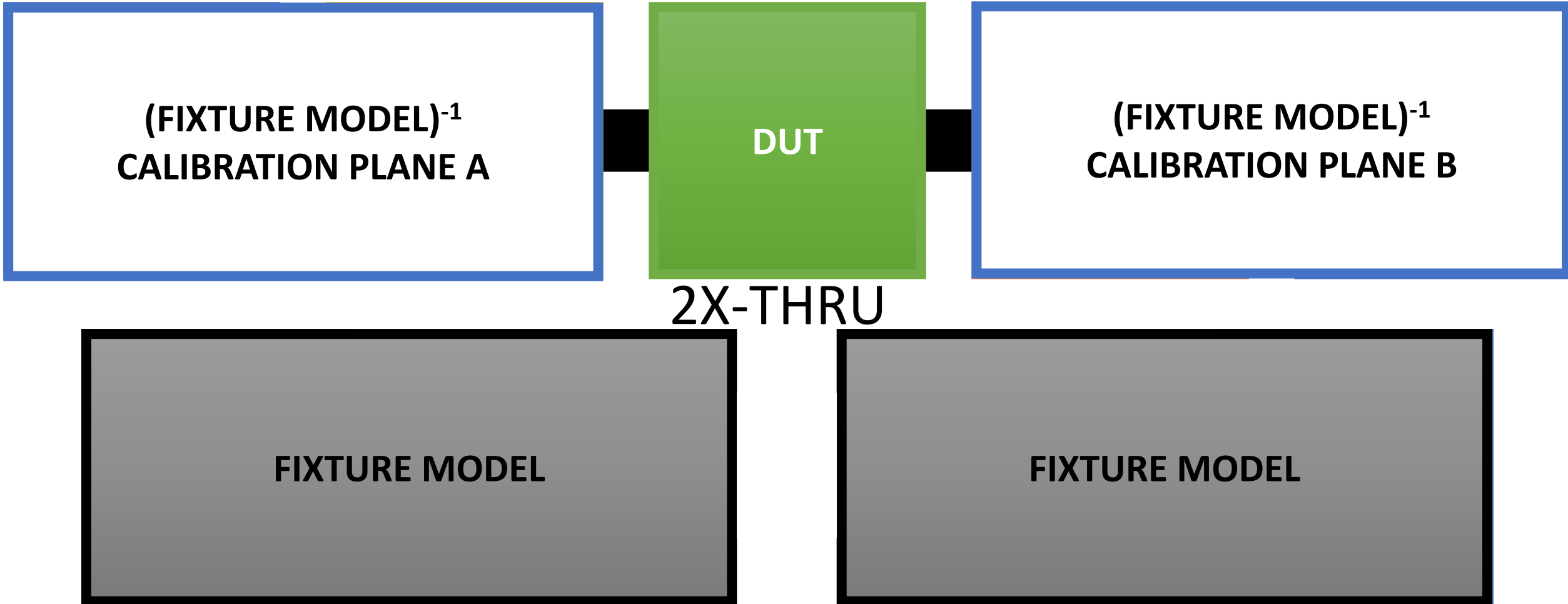
DUT

$(\text{FIXTURE MODEL})^{-1}$
CALIBRATION PLANE B

2X-THRU

FIXTURE MODEL

FIXTURE MODEL

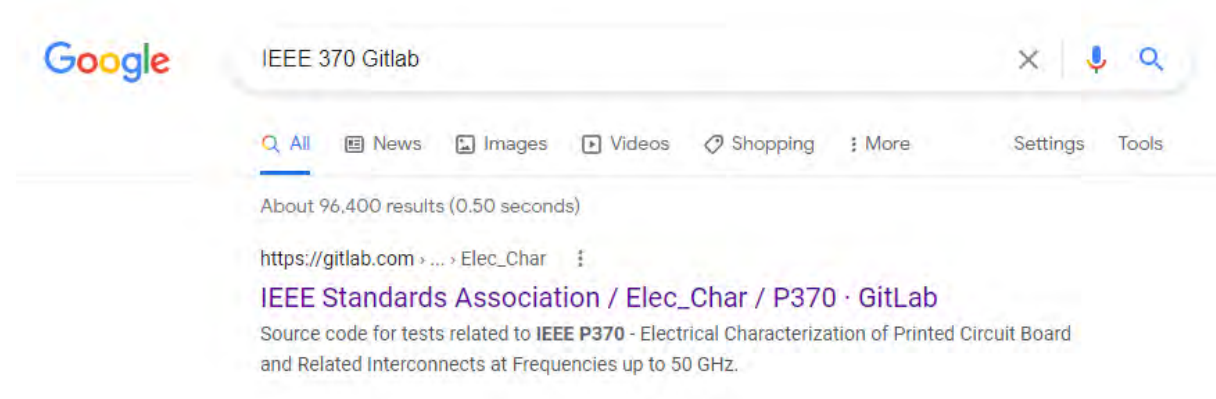


Where Do I find the Code?

Website:

<https://gitlab.com/IEEE-SA/ElecChar/P370>

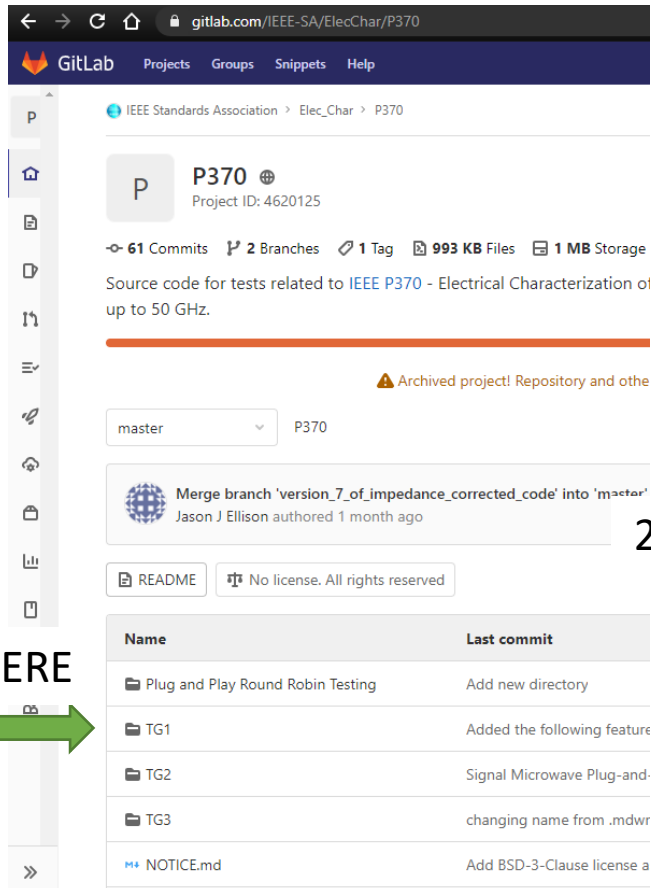
Google Search:



New website (IEEE membership required):

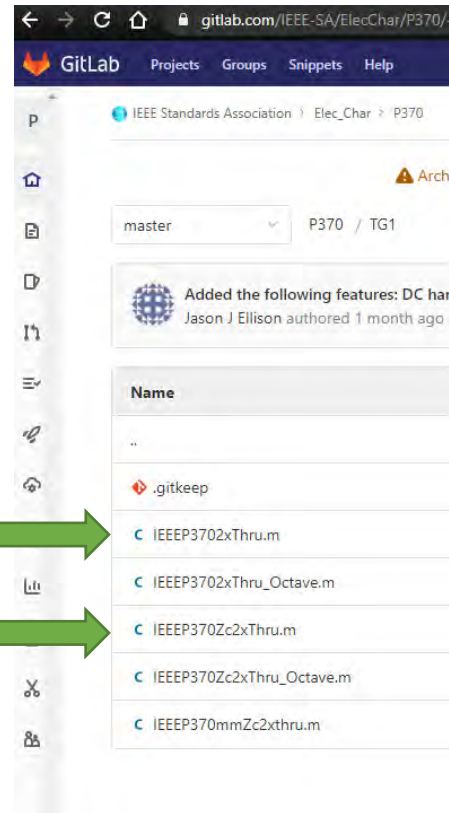
<https://opensource.ieee.org/elec-char/ieee-370>

Where Do I find the Code?



2x-thru algorithm

ZC algorithm



The **2x-thru algorithm** creates error-boxes which match the 2x-thru perfectly.

Usage cases:

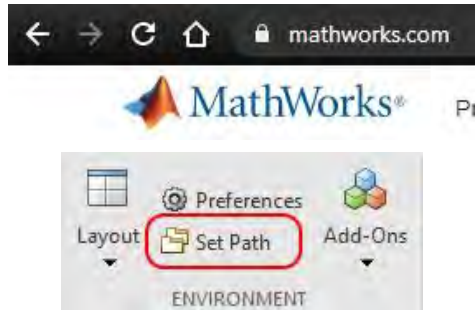
- Where speed matters
- The 2x-thru and Fixture-DUT-Fixture traces are well matched.

The **ZC algorithm** creates error-boxes which match the Fixture.

Usage cases:

- Causality is important.
- Reference plane movement is required.
- Measurement-Simulation correlation.

How do I use the code?



Install MATLAB and the RF-TOOLBOX

Put the functions in your MATLAB path

Load a 2x-thru

Load a Fixture-DUT-Fixture

Extract the error-boxes

Remove the error-boxes

```
fx >> s2x = sparameters("example_2x_thru.s2p");|
```

```
fx >> fdf = sparameters("example_fdf.s2p");
```

```
fx >> [side1,side2] = IEEEP3702xThru(s2x);|
```

OR

```
fx >> [side1,side2] = IEEEP3702c2xThru(s2x,fdx);|
```

```
fx >> dut = deembedsparams(fdf,side1,side2);|
```

How do I use the code?

Options:

The options are setup as name-value pairs.

NAME

“z0”

“bandwidth”

“view”

“pullback”

“pullback1”

“pullback2”

“side1”

“side2”

```
[side1,side2] = IEEEPP370Zc2xThru(s2x,fdF,"z0",45);|
```

VALUE

Reference Impedance | Default: 50

Fit attenuation to a limited bandwidth | Default: 0

View the de-embedding process | Default: false

Number of discrete points to omit | Default: 0

Pullback on side1 only | Default: 0

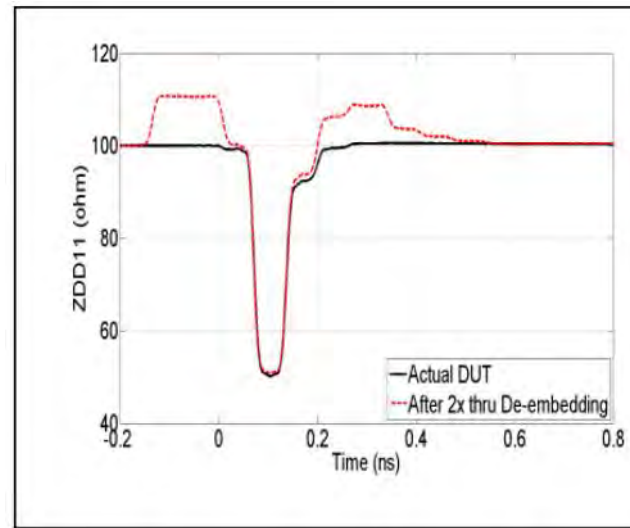
Pullback on side2 only | Default: 0

Enable side1 de-embedding | Default: true

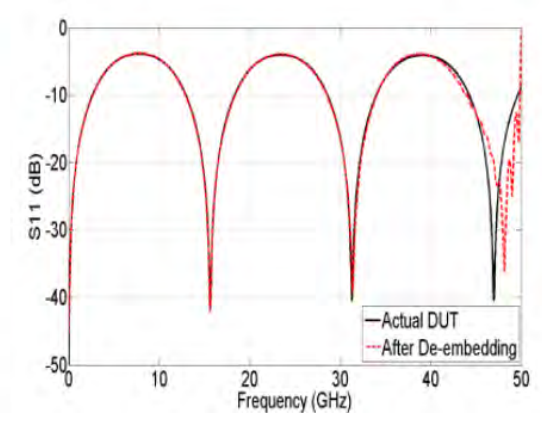
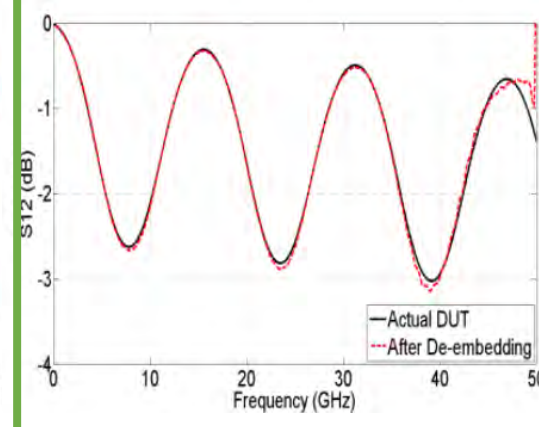
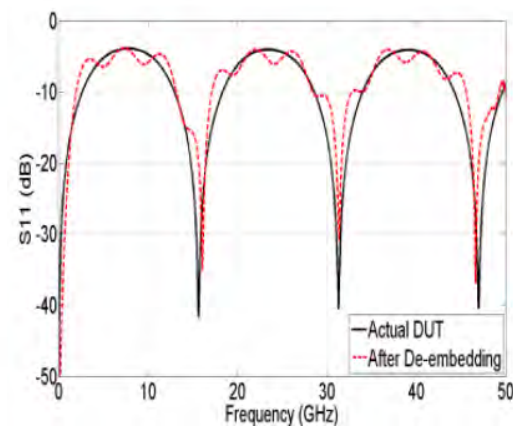
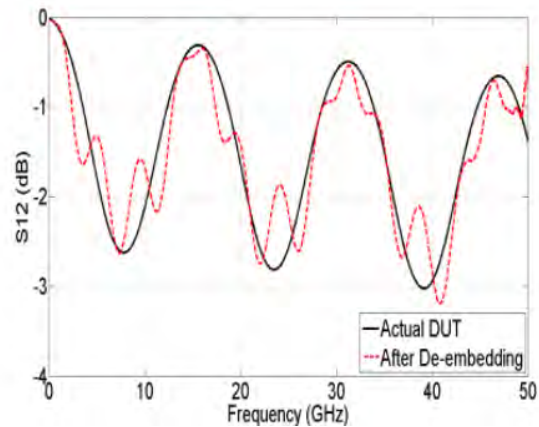
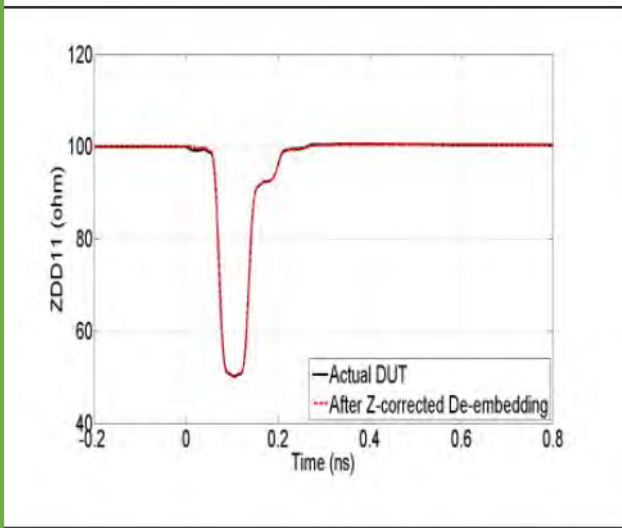
Enable side2 de-embedding | Default: true

How do I use the code?

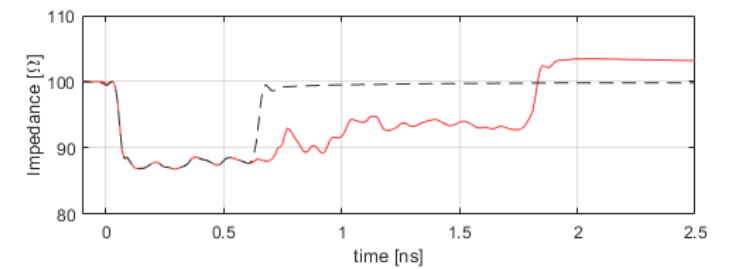
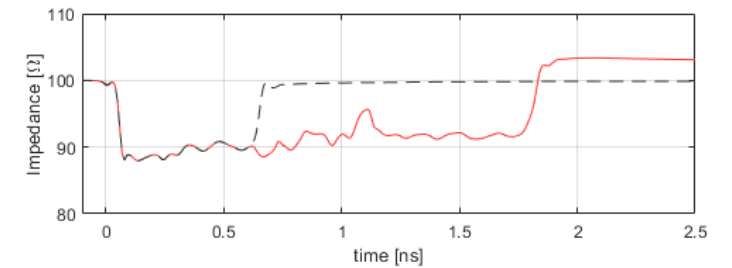
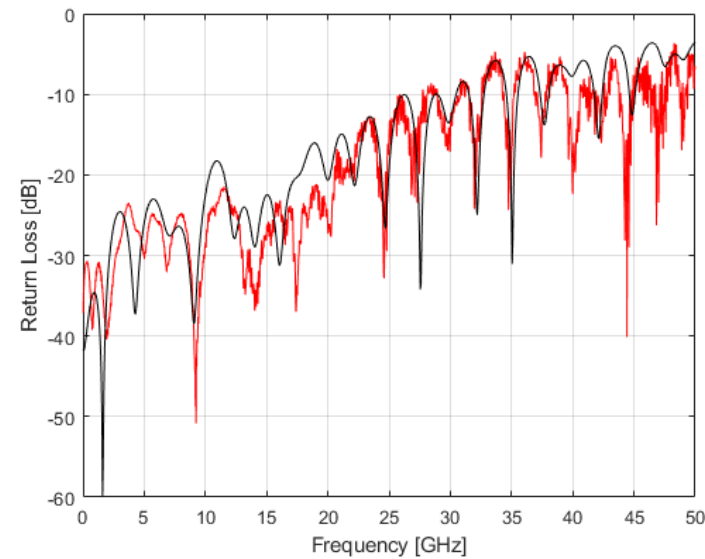
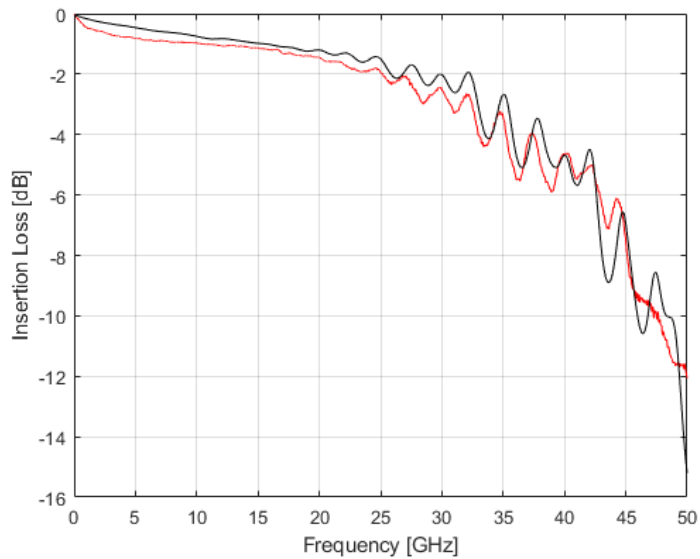
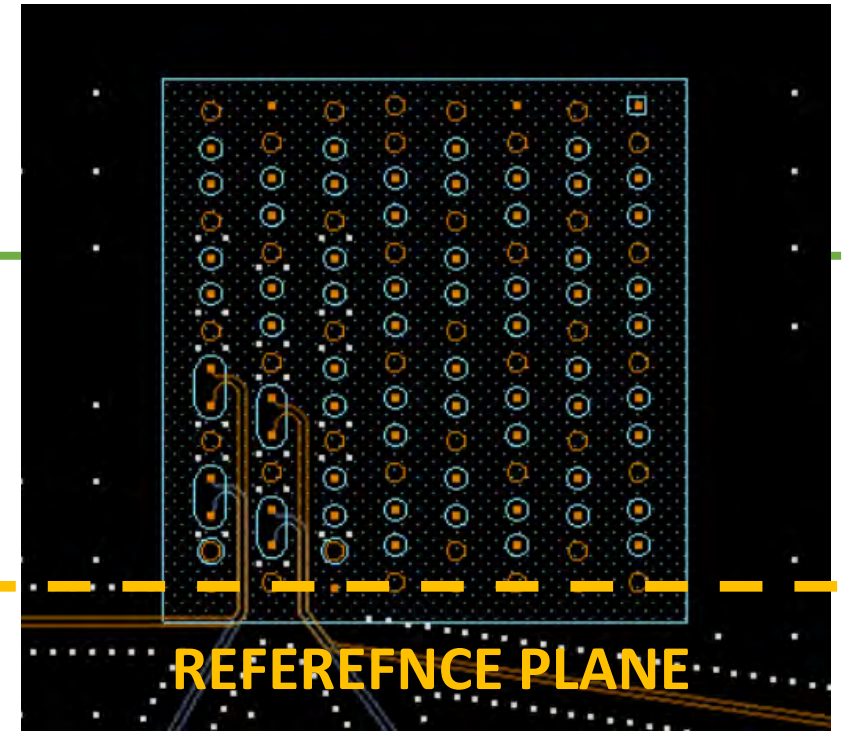
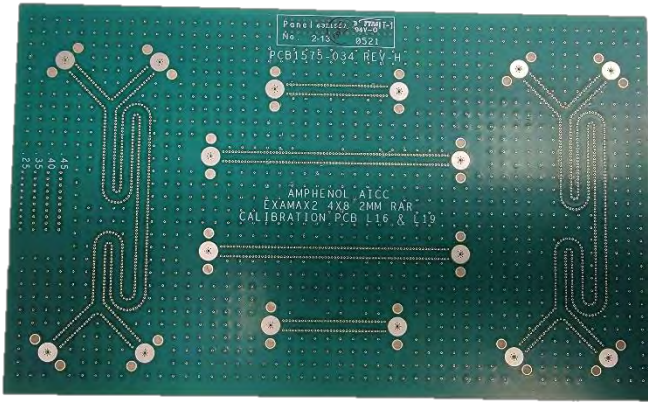
2x-Thru De-embedding



Impedance Corrected 2x-Thru De-embedding



How do I use the code?



How much does it cost?

The cost of a MATLAB license with RF-toolbox. (not a paid promotion)

The screenshot shows the MATLAB licensing interface. On the left, there are navigation tabs: Standard (selected), Education, Home, and Student. The 'Individual' license is selected, with a description: "Select this license if you are an end user and you want to operate, install, and administer the software yourself. Your organization can also designate an administrator to manage a group of Individual licenses for the convenience of centralized administration." Below this, there are options for "Network Named User" and "Concurrent".

The main content area is divided into two columns: "MATLAB" and "RF Toolbox".

MATLAB Pricing:

- USD 2,150 Perpetual license
- USD 860 Annual license

Buttons: Buy now, —View another product—

Price applies for purchase and use in United States. For pricing in other regions [contact sales](#). Pricing excludes TAX/VAT.

RF Toolbox Pricing:

- USD 1,350 Perpetual license
- USD 540 Annual license

Buttons: Buy now, —View another product—

Required Products: MATLAB

Price applies for purchase and use in United States. For pricing in other regions [contact sales](#). Pricing excludes TAX/VAT.

IEEE membership

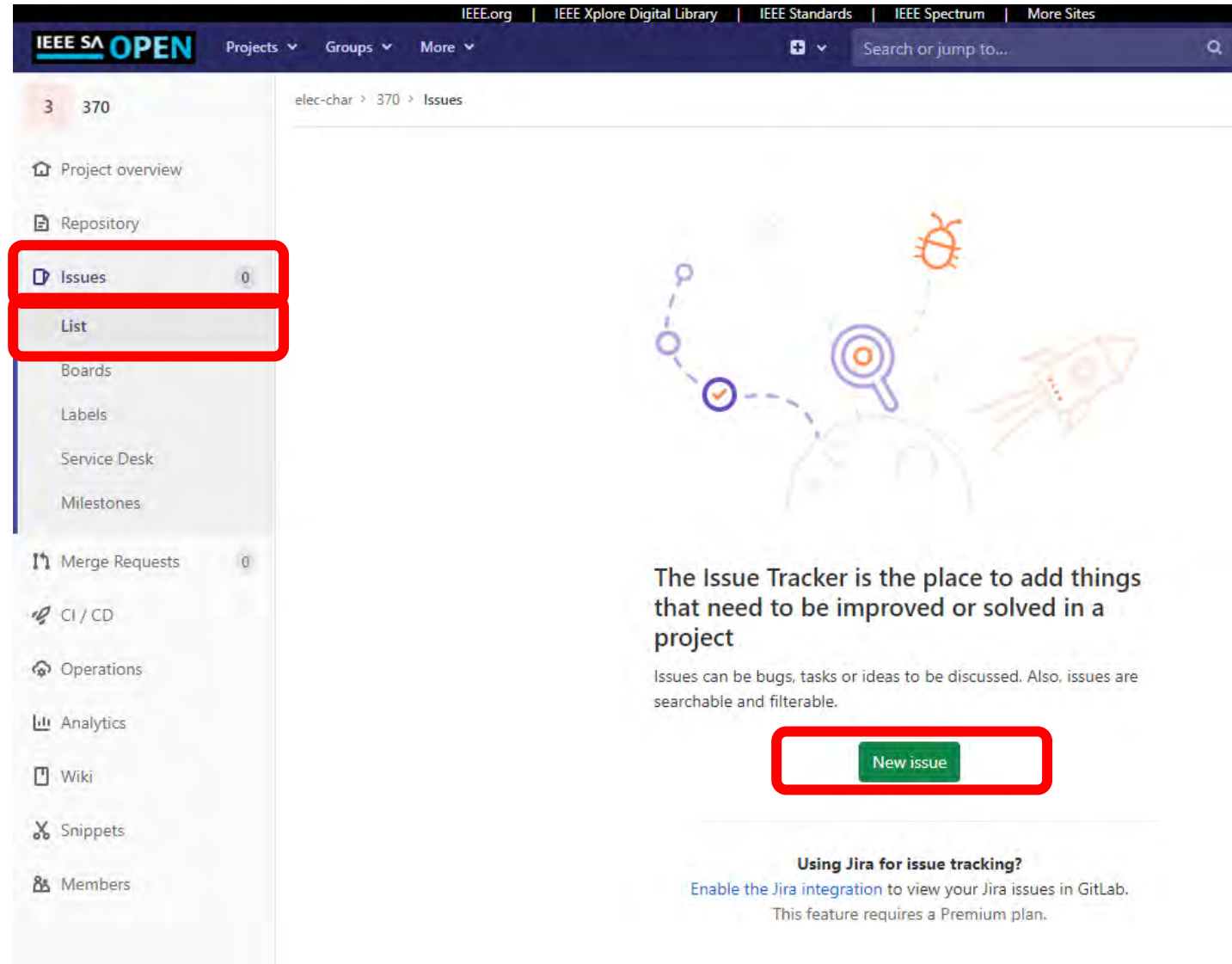
IEEE Membership Prices

Professional - Traditional	US\$104.00
Student Member	US\$16.00

The highlighted price is estimated based on the selected membership and may be adjusted when added to the cart.

Example of standard pricing. Recorded 4/5/2021
Prices do vary.

How can I Contribute?



The screenshot shows the IEEE SA OPEN project page for 'elec-char > 370 > Issues'. The left sidebar contains navigation options: Project overview, Repository, Issues (0), List, Boards, Labels, Service Desk, Milestones, Merge Requests (0), CI / CD, Operations, Analytics, Wiki, Snippets, and Members. The 'Issues' and 'List' items are highlighted with a red box. The main content area features a graphic with a magnifying glass, a bug, and a rocket, with the text: 'The Issue Tracker is the place to add things that need to be improved or solved in a project. Issues can be bugs, tasks or ideas to be discussed. Also, issues are searchable and filterable.' A green 'New issue' button is highlighted with a red box. At the bottom, there is a section titled 'Using Jira for issue tracking?' with the text: 'Enable the Jira integration to view your Jira issues in GitLab. This feature requires a Premium plan.'

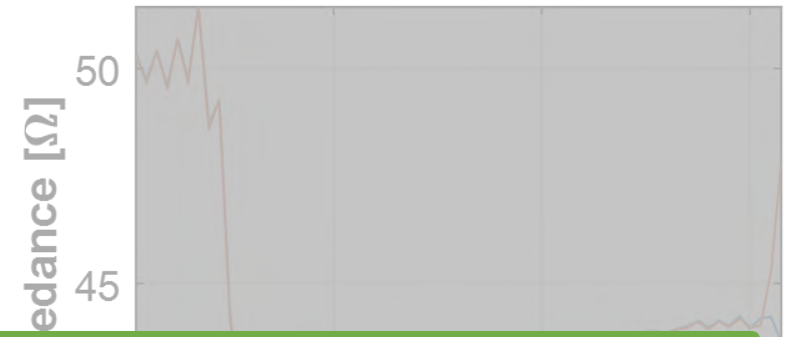
[Jason Ellison](mailto:jason.j.Ellison@ieee.org)
jason.j.Ellison@ieee.org

[Josh Gay](mailto:j.gay@ieee.org)
j.gay@ieee.org

Side 1 Fixture



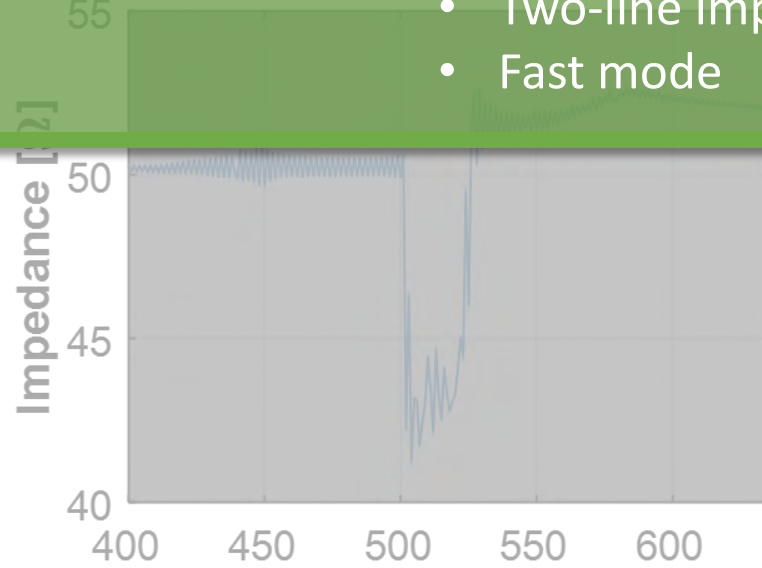
Side 2 Fixture



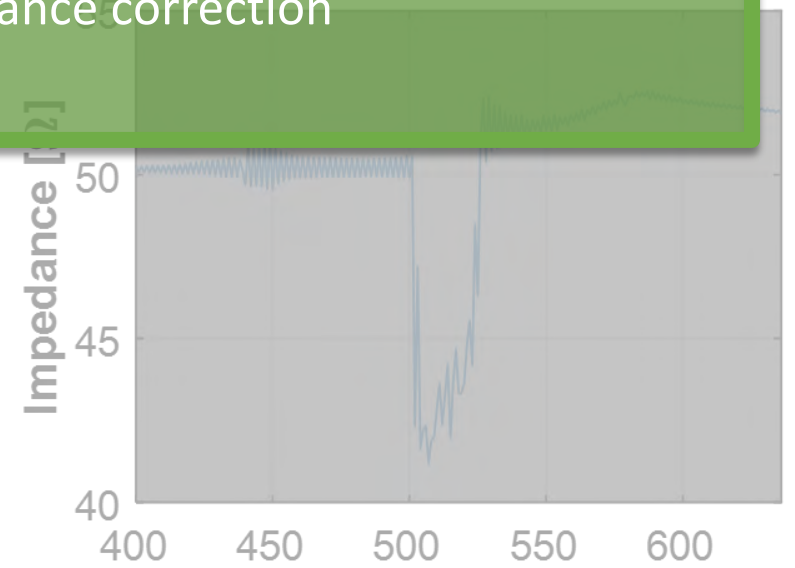
Future Enhancements

- Interface enhancement
- Lead-in adjustment
- Fractional delay enforcement
- Improved transmission line impedance definition
- Two-line impedance correction
- Fast mode

Side 1 DUT



Side 2 DUT



THANK YOU!

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