ANSA and µETA as a CAE Software Development Platform

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Overview

• What have we have done so far

• Current state

• Future direction
Scripting – Application Programming Interface

• A user can programmatically interact with ANSA and μETA.

• Users can create their own custom functionality

• Users can extend existing functionality to fit their simulation processes.
What have we given you so far

A big library of APIs that give access to the core of the programs

ANSA 1700

GUI 700

μETA 1550
What have we have given you so far

The BETA Script programming language

- A custom made language developed and maintained by BETA
- A combination of many features from languages inspired by C
- It worked well all these years. It helped in the wide adoption of scripting in the ANSA and μETA community
User Centered Development

Creative community

User

BETA Developers

BETA Support

Engineering Services

User
Applications of ANSA Scripting
ANSA Teamcenter Interface Tool

- TC – ANSA interaction brings the worlds of PDM/PLM and CAE closer
- Exchange is facilitated through a common working space and a single PLM XML file
NVH Console

- Assembly of components via connectors
- Driving actions for NVH FRF-based analyses
Process Automation – Task Manager

- Restrain Integrity (Sled Test)
- Seatbelt Static Strength
- ISOFIX
- Liftgate Slam Analysis
FMVSS201U Automated Process for Volvo Cars

- Automatic Targeting
- Positioning achieving maximum vertical angle and Conservative positioning
- Massive Positioning and Output keyword files
- Robustness studies for the worst case scenario
μETA Toolbars

Euro NCAP Score: 80.25 89.2%
Total (with HIC): 90 100.0%

- Yellow: 3 3.3%
- Orange: 2 2.2%
- Brown: 6 6.7%
- Red: 2 2.2%

ANS.A & μETA as a CAE Software Development Platform
Beyond BETA Script
Why change?

• BETA Script has reached its limitations

• A modern language was needed

• More functionality. 4000 functions are not enough.

• Access more technologies

• A more popular language worth investing in for the users.
Why Change?

Compute the eigenvalues and right eigenvectors of a square array.

\[ A = \begin{bmatrix} 9 & 13 & 5 & 2 \\ 1 & 11 & 7 & 6 \\ 3 & 7 & 4 & 1 \\ 6 & 0 & 7 & 10 \end{bmatrix} \]

**Algorithm Lanczos**

- \( v_1 \leftarrow \text{random vector with norm 1.} \)
- \( v_0 \leftarrow 0 \)
- \( \beta_1 \leftarrow 0 \)
- **Iteration:** for \( j = 1, 2, \ldots, m \)
  - \( w_j \leftarrow Av_j \)
  - \( \alpha_j \leftarrow w_j \cdot v_j \)
  - \( w_j \leftarrow w_j - \alpha_j v_j - \beta_j v_{j-1} \)
  - \( \beta_{j+1} \leftarrow ||w_j|| \)
  - \( v_{j+1} \leftarrow w_j / \beta_{j+1} \)

return
Why Change?

Find the points where two given functions intersect

\[ y_1 = x_1^2 \]
\[ y_2 = x_2 + 1 \]
Why Change?

Run External C/C++ code

```c
struct tnode
{
    char    *keyword;
    int     count;
    struct tnode *left;
    struct tnode *right;
};

int main(int argc, char **argv)
{
    if (argc != 2)
    {
        printf("Error! Wrong number of arguments was given \n");
        return 1;
    }

    printf("Reading: %s\n", argv[1]);

    struct tnode *root;
    root = NULL;

    ParseFile(argv[1], &root);
    treeprint(root);
    tfree(root);
    return 0;
}

int ParseFile(char *fileMain, struct tnode **root)
{
}
```
The Answer is
python + Libraries
Why Python?

• High level object oriented programming language

• Clear and expressive syntax

• Large Standard Library

• Large Selection of third party scientific and mathematical libraries

• Is emerging as the language of choice for computational sciences and engineering
Immediate benefits

- Access to a huge number of standard python modules
- Access to 3\textsuperscript{rd} party open source libraries (NumPy, SciPy, MatPlot lib etc)
- Ability to run external code written in C / C++
- Abundance of helpful resources on the internet.
- New engineering graduates may already know Python
Libraries
Libraries – NumPy

Compute the eigenvalues and right eigenvectors of a square array.

\[
A = \begin{bmatrix}
9 & 13 & 5 & 2 \\
1 & 11 & 7 & 6 \\
3 & 7 & 4 & 1 \\
6 & 0 & 7 & 10
\end{bmatrix}
\]

Algorithm Lanczos
\[
v_1 \leftarrow \text{random vector with norm } 1.
\]
\[
v_0 \leftarrow 0
\]
\[
\beta_1 \leftarrow 0
\]

Iteration: for \( j = 1, 2, \ldots, m \)
\[
w_j \leftarrow Av_j
\]
\[
\alpha_j \leftarrow w_j \cdot v_j
\]
\[
w_j \leftarrow w_j - \alpha_j v_j - \beta_j v_{j-1}
\]
\[
\beta_{j+1} \leftarrow ||w_j||
\]
\[
v_{j+1} \leftarrow w_j / \beta_{j+1}
\]
return
Libraries – SciPy

Find the points were two given functions intersect

\[ y_1 = x^2 \]
\[ y_2 = x_2 + 1 \]

```python
from scipy.optimize import fsolve

def f(xy):
    x, y = xy
    z = np.array([y-x**2, y-x-1.0])
    return z

fsolve(f, [1.0, 2.0])
```
Libraries – NumPy + SciPy

- Array Handling
- Linear Algebra
- Interpolation
- Differential Equations
- Optimization
- Signal Processing
- Statistics
- Fitting Techniques
- and many more...
import matplotlib.pyplot as plt

def my_plot():
    file = open('/home/yianni/sled_pulse.txt')
    x_vals = list()
    y_vals = list()
    for line in file:
        ret = line.split(',
        x_vals.append(float(ret[0]))
        y_vals.append(float(ret[1]))
    plt.suptitle('Acceleration Pulse')
    ax = plt.subplot('111')
    ax.plot(x_vals, y_vals)
    plt.show()
Platform Overview

Development Platform

ANSA-μETA
Core Functionality

Matlab like functionality

Infinite additional capabilities (webdevel, http connections etc.)
“Python is a super glue for modern scientific workflow”

by Joshua Bloom, PhD

University of California, Berkeley
Astronomy Department
ANSA & μETA as a CAE Software Development Platform
Examples of the New Capabilities
Robustness Analysis Tool

FMVSS201U Analysis is highly dependent on positioning parameters
Robustness Analysis Tool

- Automatically create a robustness analysis for a safety loadcase
- Automatically manage solver runs and compile a report
Robustness Analysis Tool

- Horizontal Angle APR vs HIC
- Vertical Angle APR vs HIC
- Distance APR vs HIC
- HIC distribution
Robustness Analysis Tool
Robustness Analysis Tool

Python Benefits

- Use of the NumPy library to run MonteCarlo Method
- Use of the MatPlot lib to plot
- Use of a pdf library to create the pdf report
- Allow user to implement the desired statistical analysis or modify process
Check your CAE model before you send it...

Hello John,

I know that you are out to the office. However, I would like you to make sure that you got the correct model on your USB stick.

Login to the VPN and verify that the model is OK by using the link below:

**Application:** [Online ANSA Deck Info](#)
Next Steps
Future Direction

- Enrich the existing ANSA and μETA API

- Allow access to lower level functionality (i.e. User Defined Entities)

- Move to a more object oriented design

- Help more people to join the community
Future Direction

Plugin Manager

Development Platform

Distribute

Plugins

Embedded Apps

Users

ANSA & μETA as a CAE Software Development Platform
Thank You
ANSA and μETA as a CAE Software Development Platform

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