

ArvinMeritor

ArvinMeritor ADEPT allowing “non-users” to access Flowmaster

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*Roger J Chuter,
Principal Systems
Engineer,
ArvinMeritor*

ArvinMeritor is the largest light vehicle exhaust system manufacturer in the world, providing full system solutions to global customers such as Ford, General Motors, DaimlerChrysler, Fiat, Renault, PSA, Volkswagen, Toyota and BMW. They lead the field in technology advancements with solutions such as Air2Air and T3 titanium exhaust systems. Their Air2Air technology optimises engine air flow and related Noise, Vibration and Harshness (NVH), while reducing vehicle development time and expense.

ArvinMeritor focuses on providing customers with innovations addressing engine performance, fuel economy and emissions, mass reduction and NVH.

In addition to full exhaust systems, ArvinMeritor supplies automakers with components such as fabricated manifolds, maniverters, catalytic converters, mufflers, resonators, exhaust trims, speciality piping and air filters.

ArvinMeritor is the largest light vehicle exhaust system manufacturer in the world. They lead the field in technology advancements with solutions such as Air2Air and T3 titanium exhaust systems. ArvinMeritor’s UK R&D Centre use Flowmaster.



ArvinMeritor's UK exhaust system Research & Development centre is at Warton, Lancashire. This location has responsibility for most of ArvinMeritor's European customers and is home to the European Advanced Engineering Operation.

Introduction

The UK R&D centre had used 3D CFD software codes to model exhaust systems. However, a typical analysis could take an overnight run, which was too slow. ArvinMeritor needed a faster solution and chose Flowmaster - 1D analysis code with modest data requirements and short run times - typically only a few minutes rather than hours.

Modelling Techniques

After initial training ArvinMeritor's engineers were able to use Flowmaster to successfully to model pressure and temperature distribution in automotive exhaust systems. They found it necessary to develop modelling techniques for exhaust system elements for which there was no Flowmaster component model. These include - catalytic converters, perforated flow elements, absorptive pack and diesel particulate filters.

They used two main techniques for this:

- Develop loss coefficient curves and add them to components.
- Write External Component Models. In particular, they developed a comprehensive ECM that models catalytic converter light off and exothermic reactions for catalytic converters.

With these techniques they achieve very high levels of accuracy. Flowmaster models of cold flows give 97% accuracy when correlated against flow rig measurements, as good as 3D CFD but in a fraction of the time. However, hot flow is not so accurate - typically 86%. Further development is ongoing to improve this. This is concentrating on various methods of extracting heat from the existing models.

The availability of Flowmaster analysis tool led to the requirement for a specialist user who was trained in its use. However, ArvinMeritor's aim was to have a system that could be used by non-specialists and deliver accurate results. There was also a requirement to prevent modification of the original models.

ADEPT Development

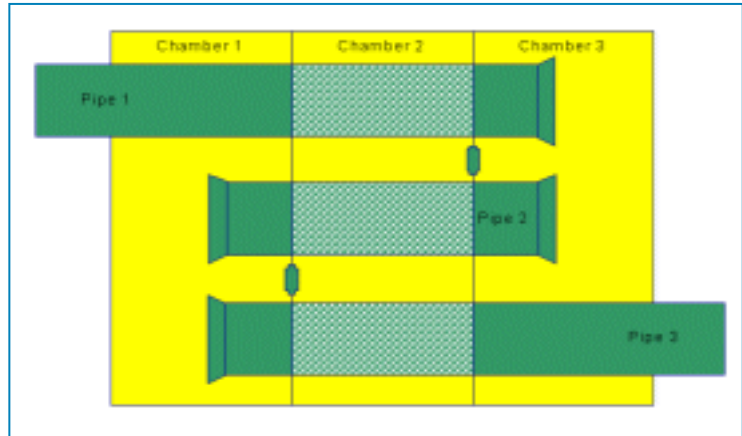
These aims led to the development of ADEPT - ArvinMeritor Design Exhaust Prediction Toolbox. ADEPT allows development engineers to analyse muffler designs without entering the Flowmaster domain. The system was specified by Roger J Chuter, ArvinMeritor UK R&D's Principal Systems Engineer, and developed by him in conjunction with Geoff Holden, a computing graduate from Purdue University. It is built on Microsoft's Excel spreadsheet system, a commonly used tool, and uses Flowmaster's automation functions to call the analysis code. This allows development engineers to use a familiar environment to access the power of Flowmaster without the

requirement for specialist training.

ADEPT presents the development engineer with a series of muffler types. The mufflers were chosen to demonstrate the capabilities of the system prior to expansion into a full system model. It is envisaged that the final release will also incorporate the CELLCALC catalytic Converter ECM developed at ArvinMeritor's UK R&D Centre.

The 3-pass muffler is a commonly used type with many variants including:

- flared inlets or outlets to pipes.
- unequal pipe diameters.
- plain or perforated baffles.
- plain or perforated pipes.
- centre pass as a pipe or as a pierced baffle.
- empty or with absorptive packing.



Schematic of ArvinMeritor's 3-pass muffler. Engineers can choose from plain or flared pipe ends, plain or perforated baffles and pipes, centre pass as pipe or pierced baffle and optional absorptive packing offering a large number of possible solutions. The wide range of variants can lead to a large number of possible solutions. During an analysis the design engineer uses a custom wizard to select a muffler type, the variants and to enter values for the key design parameters. ADEPT then calls Flowmaster, the data is input to the selected model and a pre-determined set of results retrieved and displayed in ADEPT forms.

ADEPT Benefits

The main benefit of ADEPT and Flowmaster is that a development engineer can now design and optimise system back-pressure in less than a day when it used to take a week. This productivity has more than justified the purchase of Flowmaster and the development of ADEPT.

Conclusions

ADEPT illustrates the power and flexibility of Flowmaster as part of a design environment. Called from Excel, it allows non-specialists users to get the analysis power they require without needing to learn another product. Also, a specialist can prepare the models and allow a non-specialist to use them without ability to modify. Also, protection can be set on data fields so that only specific parameters can be modified. ADEPT verification work is progressing at Warton Technical Centre and the system has been trialled in the Columbus Technical Centre, USA. The initial response from Business Group Engineers is very favourable.

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