

Final Report Summary Finite Element Analysis for the SME Sector



Piezo Composite Transducers Ltd
<http://www.pct-ltd.co.uk>



University of Paisley
<http://www.paisley.ac.uk>

A feasibility study was undertaken to determine if Finite Element Analysis (FEA) was a cost effective means for product design and refinement applicable to small and medium-size enterprises (SMEs). The study involved a partnership between PCT (Piezo Composite Transducers Ltd), Aberdeen, and the Microscale Sensors Research Group at the University of Paisley.

The three aims of the feasibility study were to:

1. Determine what software would be required to meet the needs of PCT.
2. Determine what hardware would be required run the selected software.
3. Minimise the time and manpower taken to analyse problems by developing user friendly interfaces at the University of Paisley.

Established in 1997 and based in Aberdeen, PCT provides high performance acoustic transducer solutions for a wide variety of underwater applications. Drawing upon a range of advanced transduction technologies, PCT is able to optimise transducer designs to meet desired acoustic specifications. PCT specialises in advanced 1-3 Piezo-Composite devices that utilise the improved properties of ceramic rods embedded in a customised polymer matrix. This construction forms the basis for enhanced range capability and image quality when compared to conventional monolithic designs. With PCT's experience and expertise in state-of-the-art acoustic/mechanical systems – combined with their manufacturing facilities – PCT is able to provide complete engineered solutions to meet most transducer requirements.

Established in 2004, Microscales Sensors is part of the University of Paisley's Schools of Computing and Science & Engineering. The group has attracted in excess of £1million of funding in the last two years to support a strong cohort of researchers and excellent state-of-the-art research labs. The group has expertise in ultrasonic design and applications underpinned by generic skills in mathematical modelling and FEA. Microscale Sensors collaborate with academic groups and commercial organisations at local, national and international levels – establishing joint projects through a variety of mechanisms including CASE studentships, TTOM, KTP, dti LINK, EPSRC funding and EU project schemes.

FEA consists of a computer model of a product (in this feasibility study, a piezoelectric transducer) loaded with its operating conditions and analysed for specific results. It is possible to verify a proposed design prior to manufacturing, and be able to modify an existing product to qualify for new service conditions. In FEA, a product is broken down into many small simple blocks or elements. The behaviours of an individual element can be described with a relatively simple set of equations. Just as the elements could be assembled together to build the whole product, the sets of equations can be linked together to describe the product's behaviour. Finite Element Analysis is carried out principally with commercial software.

To establish the software and hardware necessary to meet the needs of PCT two benchmarks – set by the National Agency for Finite Element Methods and Standards (NAFEMS) – were carried out with a variety of FEA packages. Taking into account accuracies, solver times and costs it was demonstrated that COMSOL Multiphysics and a high-end PC with Windows Server 2003 and 2GB of system memory would satisfy most of their requirements.

TTOM.org.uk

Delivered by the



Co-funded by:



SCOTTISH EXECUTIVE



University to SME Technology Transfer in Optoelectronics and Microelectronics

The above set-up was successfully used to model the electrical and mechanical characteristics of a segmented ring composed of PZT-4D, and simulate the pressure wave emitted from a slab of PZT-5H pulsed with an electrical signal – one complete cycle at the fundamental resonance frequency.

The COMSOL Script environment allowed for the creation of a graphical user interface – specific to the needs of PCT – where a non-FEA specialist could model the electrical and physical characteristics of a piezoelectric block. The client would: enter the dimensions of the block; set meshing parameters manually or automatically; set material properties manually or automatically; enter loss parameters; and set frequency ranges. Visualisations of the results could be obtained through the 'click-of-a-button'.

At a direct result of this project, further funding to continue the work is being sought. It is hoped to develop the graphical user interface to allow PCT to model and refine much more complex structures and to develop macros that would permit underwater beam characteristics to be simulated.

TTOM.org.uk

Delivered by the



Co-funded by:



SCOTTISH EXECUTIVE

