IOMM Superplastic Committee

Road map thoughts for computer simulation of SPF

Finite element SPF simulation (FE-SPF) can be considered as a virtual manufacturing environment within which SPF process ideas can be subject to investigation without the need for expensive practical experimentation.

A recent trawl through the literature [#] on FE-SPF reveals that a number of commercial and private FE-SPF computer programs exist claiming an ability to successfully simulate SPF. However it is the author's experience that, to use the current phraseology, there are a number of systemic problems associated with such simulation. These are; whether to use membrane, shell or solid elements for the representation of the sheet material; numerical solution problems associated with mechanisms or very ill conditioned equations that exist in the initial flat configuration; solution problems associated with friction modelling and finally what constitutive equations should be used.

There appears to be a gradual realisation in industry the FE-SPF may be able to confer some commercial advantage. But for FE-SPF to be accepted, industry needs to have confidence in the software it is likely to have to purchase for the task.

Before this evaluation can be undertaken a number of test problems need to be established, for example:

1. Simple free bulging of a circular sheet
2. Simple free bulging of a rectangular sheet.
3. Forming into a circle cone
4. Forming into a rectangular (box) die
5. Forming into a typical industrial component
6. Forming of a medical prosthesis with a complex die geometry

These tests will need to be completely specified with respect to sheet and die dimensions (IGES file or triangulation), boundary conditions, constitutive equations (simple K/m and other), friction coefficient (test to include sticking, sliding and friction cases), given pressure profile and strain rate and/or flow stress governed calculated pressure profile, use of membrane, shell or solid elements. In addition output format would need to be specified, (graphs, tables, timings etc).

I would suggest a small group to advise on these tests. Here we could involve our European colleagues.

Similar test have already been undertaken by the non SPF sheet forming community (with amazingly differing results !).

This evaluation of available software could be undertaken in a number of ways;

(a) Disseminating the tests to private and commercial FE-SPF analysts. This would probably require an initiative from the IOMM SPF committee so that the commercial software developers could see the possibility of their software becoming the industry 'standard'.

(b) Disseminating the tests to private analysts and contracting a research group (or individual private groups who already use commercial software) to carry out tests on the commercial software. This may require funding for staff, equipment and software but would have the advantage that hands on experience could be relayed to the IOMM SPF members without commercial censoring. In addition it would provide the opportunity for future training of FE-SPF operatives.

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J. Bonet, A. Gil, R. D. Wood, R. Said and R.V. Curtis, *Simulating superplastic forming*, to be published in Comput. Meth. Appl. Mech. Eng.