# Recent Developments in JSTAMP/NV for the Best Stamping Simulation Environment

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## Abstract

*In recent years, expectations for stamping simulation systems have increased in stamping die design process, as the needs for lightweight products and short production lead time have grown. Aiming at the best stamping simulation environment, JSOL Corporation has been developing JSTAMP/NV since 1996. One of the most competitive advantages of JSTAMP/NV is accurate prediction of deformation and formability by explicit and implicit solutions in LS-DYNA®. JSTAMP/NV also incorporates the implicit solver JOH/NIKE and the one-step inverse solver HYSTAMP developed by JSOL Corporation. This integrated system has been enjoying a good reputation in stamping die industry, especially Japanese automotive, appliance, and electronics manufactures and their suppliers. The recent needs towards stamping simulation software can be classified as: accurate results and their evaluation, short computation times, easy-to-use features for iterative process improvement, and support for modern stamping technologies. JSTAMP/NV continues to evolve to meet such requirements. In this paper, we present the recent developments in JSTAMP/NV, including ironing analysis support using solid elements, Yoshida-Uemori model material database, advanced trimmed mesh, enhanced springback compensation, easy-to-start reanalysis feature, free 3D viewer for collaboration, and hot stamping analysis capability.*

## Introduction

In the industries such as automotive, appliance, and electronics, their efforts are increasing to develop lightweight products and to reduce costs and lead time. Because of this situation, a press simulation software package JSTAMP/NV has been receiving a lot of demands from customers, and has met many of the demands by offering advanced capabilities [1]. We are committed to continue providing unique and innovative solutions. In the following sections, recent developments in JSTAMP/NV are presented.

## Solid Elements Application to Ironing Analysis

JSTAMP/NV allows modeling the sheet metal by solid elements. By using solid elements for the sheet in an ironing analysis, the user can find out thinning, thickening, and through-thickness shear, which can not be evaluated when using shell elements. It is very easy to use solid elements and to specify the number of element layers through thickness in JSTAMP/NV. The post processor of JSTAMP/NV can display thickness distribution calculated from nodal coordinates on the surfaces.

Figure 1 shows a result example of an ironing analysis. Thickness distribution of the first and final ironing stages is shown. It was confirmed that the final result was in good agreement with the actual drawn part.

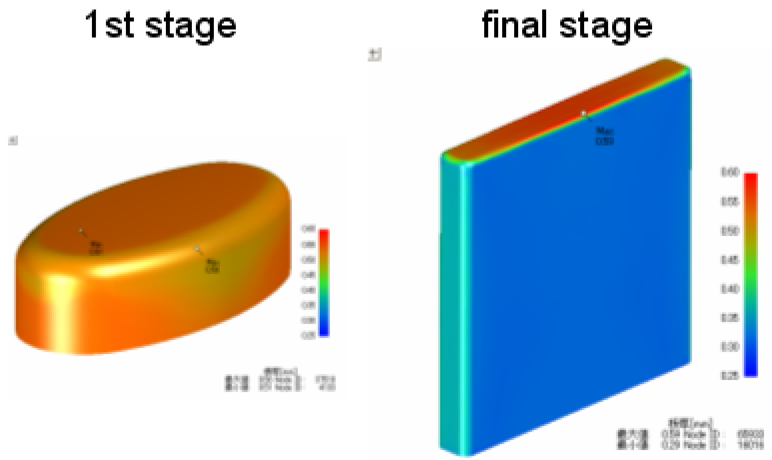
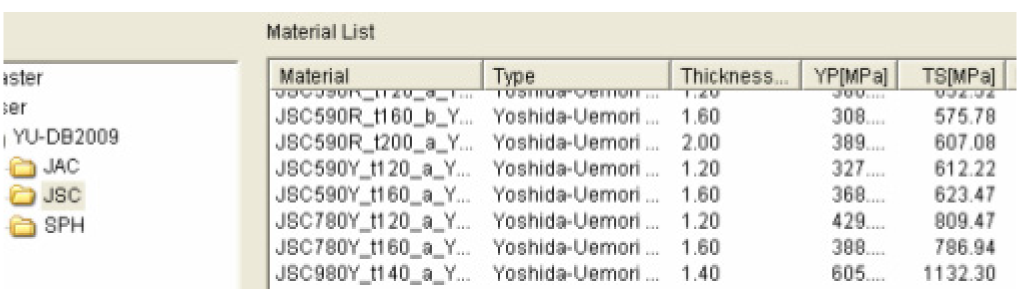



Figure 1: Example of ironing analysis (thickness distribution)

## Yoshida-Uemori Model

JSTAMP/NV supports Yoshida-Uemori material model [2]. As is generally known, it is very useful for accurate springback prediction. However, preparing numerical parameters of the model is a challenging task. Therefore, JSOL distributes MatPara, which is a material parameter determination tool developed by CEM Inst Co. [3]. The optional material database of JSTAMP/NV (shown in Figure 2) includes Yoshida-Uemori model parameters carefully determined using MatPara from our experimental results. Figure 3 illustrates the overview of material parameter determination using MatPara [4].



ıster
ser
YU-DB2009
JAC
JSC
SPH

Material List

| Material | Type | Thickness... | YP[MPa] | TS[MPa] |
|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| JSC590R_t160_b_Y... | Yoshida-Uemori ... | 1.60 | 308.... | 575.78 |
| JSC590R_t200_a_Y... | Yoshida-Uemori ... | 2.00 | 389.... | 607.08 |
| JSC590Y_t120_a_Y... | Yoshida-Uemori ... | 1.20 | 327.... | 612.22 |
| JSC590Y_t160_a_Y... | Yoshida-Uemori ... | 1.60 | 368.... | 623.47 |
| JSC780Y_t120_a_Y... | Yoshida-Uemori ... | 1.20 | 429.... | 809.47 |
| JSC780Y_t160_a_Y... | Yoshida-Uemori ... | 1.60 | 388.... | 786.94 |
| JSC980Y_t140_a_Y... | Yoshida-Uemori ... | 1.40 | 605.... | 1132.30 |

Figure 2: Material database including Yoshida-Uemori model

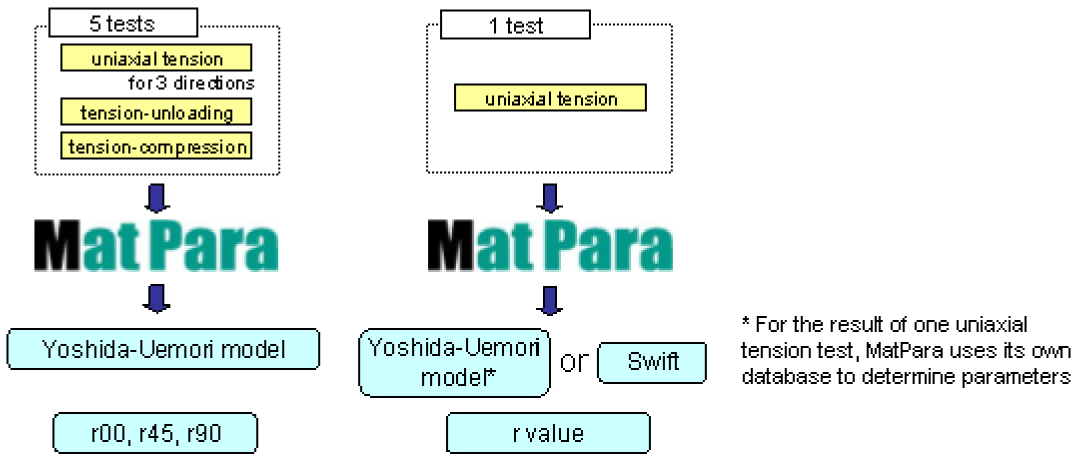



Figure 3: Overview of material parameter determination using MatPara

## Advanced Trimmed Mesh

The conventional method of trimming in software only cuts off shell elements outside trim lines. Triangular shell elements along the boundaries (trim lines) sometimes produce incorrect results in the subsequent analyses such as flanging. Incorrect excessive thinning leads to misunderstanding of formability, and incorrect stress distribution causes inaccurate springback prediction. As a countermeasure of this problem, JSTAMP/NV implements an advanced method for trimmed mesh (Figure 4). This method remeshes the formed and trimmed sheet geometry, so that quadrilateral elements are placed along the boundaries. This mesh improves accuracy and robustness of the subsequent analyses.

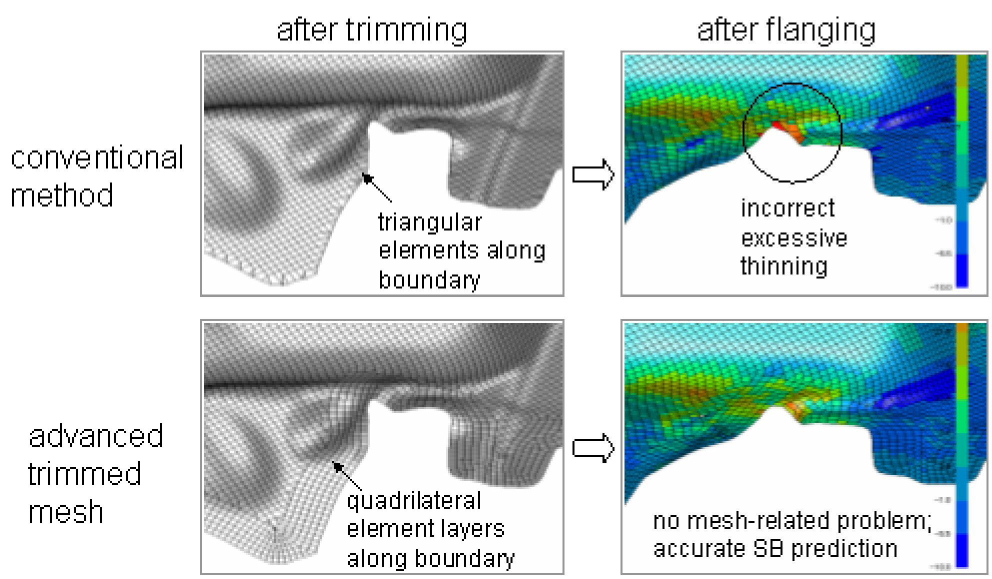



Figure 4: Comparison of the conventional and the new advanced methods

## Enhanced Springback Compensation

Springback compensation feature of JSTAMP/NV has been improved. Springback compensation procedures in JSTAMP/NV are as follows:

1. Perform a springback (SB) or springforward (SF) analysis.
2. Compensate tool meshes using SB or SF displacement.
3. Perform draw and SB analyses using the compensated tool meshes.
4. If the SB result meets the part tolerance, compensate tool CAD data in the same manner as the tool meshes and export it for CAM; otherwise go to step 2.

The latest version supports the following:

1. Specify a deformation scale factor for each surface.
2. Compensate the previous tool geometry not the initial geometry with easy operations when the previous compensation is not adequate.
3. Export high quality compensated tool CAD data.

In many cases, two or three iterations are enough to obtain the desired tool geometry. (An application example will be given in the presentation.)

## Reanalysis Feature

Reanalysis feature of JSTAMP/NV allows the user to quickly start a series of new calculations such as for gravity, binder wrap, and drawing with changed conditions including blank position, cushion stroke, cushion force, and so on. Figure 5 shows the dialog box for this feature. JSTAMP/NV also has a feature of automatic successive calculation which supports all types of solver environment including a remote MPP cluster (Figure 6). These features help to cut labor costs and to reduce lead time.

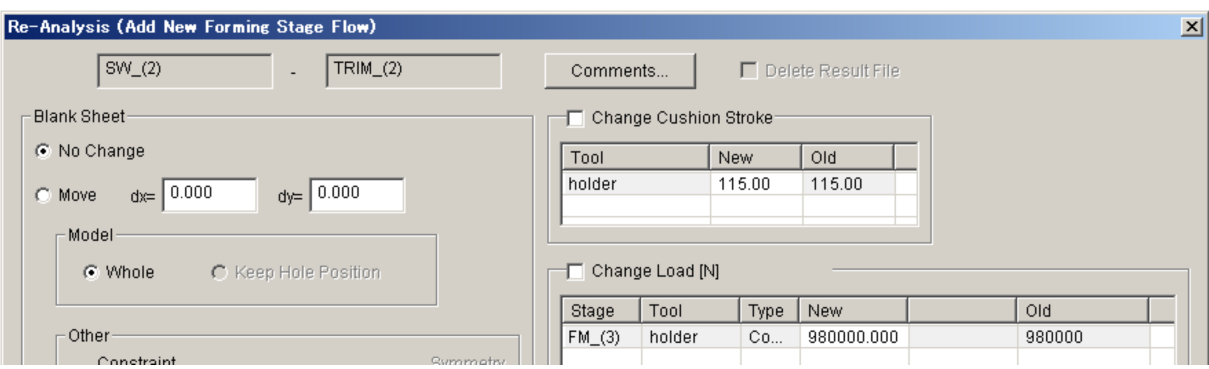



Figure 5: Part of Reanalysis dialog box

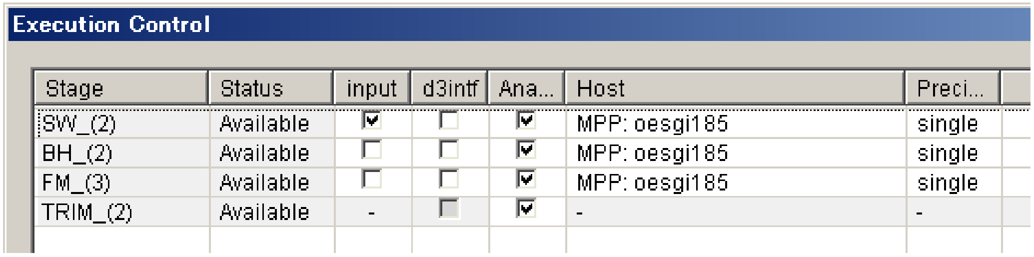



Figure 6: Automatic successive calculation support

## Free 3D Viewer to Accelerate Collaboration

We provide a 3D viewer called SmartPost, which runs smoothly and has sufficient evaluation features with easy-to-use interface. It is available free of charge to everyone including those who are not JSTAMP/NV customers. SmartPost files can be exported from JSTAMP/NV post processor. The file size can be 20 times smaller than a series of source d3plot files, because just a specified component such as thickness is contained in the file. Furthermore, SmartPost files can be displayed and operated in web browsers and Microsoft PowerPoint (Figure 7). Therefore, various collaboration scenarios can be realized, for example:

- a person in charge of formability simulation sends a SmartPost file across networks to the die design team to report problems;
- a stamping die supplier gives a persuasive PowerPoint presentation, using 3D models, on preliminary calculations to a part manufacturer for a new order.

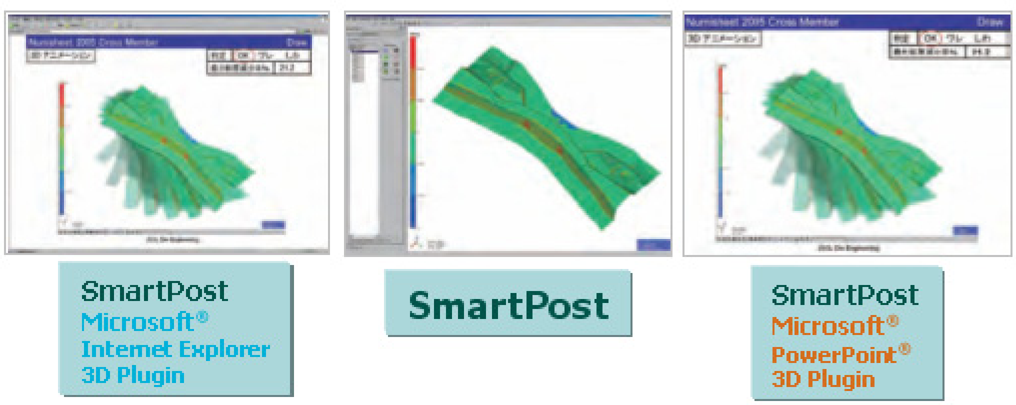
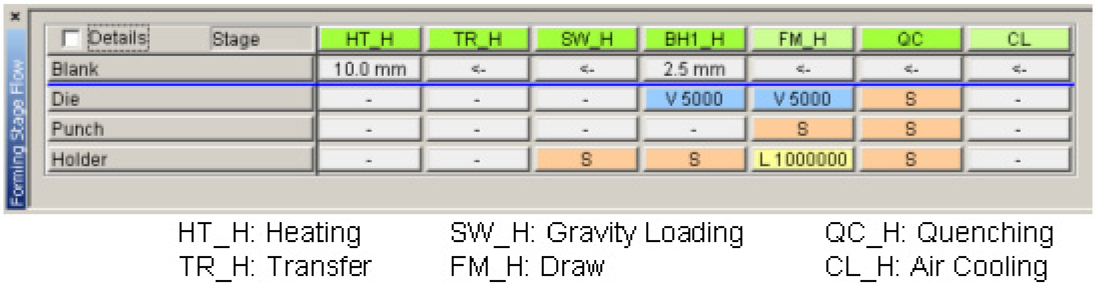



Figure 7: SmartPost free product line

## Hot Forming and Optimization

Hot forming capability has been implemented in JSTAMP/NV since the previous version (version 2.3). All types of hot forming operations from heating to air cooling can be modeled as is shown in Figure 8. An optimization example of hot forming process using JSTAMP/NV and HEEDS Professional [5] will be given in the presentation. HEEDS Professional is a design optimization software package developed by Red Cedar Technology, Inc. It implements a lot of optimization algorithms including an original hybrid, adaptive, efficient and robust algorithm called SHERPA. Integration of HEEDS Professional to JSTAMP/NV is planned in the future release so as to offer various design optimization or automation capabilities.



| Details / Stage | HT_H | TR_H | SW_H | BH1_H | FM_H | QC | CL |
|---|---|---|---|---|---|---|---|
| Blank | 10.0 mm | <- | <- | 2.5 mm | <- | <- | <- |
| Die | - | - | - | V 5000 | V 5000 | S | - |
| Punch | - | - | - | - | S | S | - |
| Holder | - | - | S | S | L 1000000 | S | - |



Figure 8: Complete modeling of hot forming operations

## Summary

Some of the recent developments in JSTAMP/NV were presented. We will continue to strive to provide the best stamping simulation environment and excellent services.

### References

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2. F. Yoshida and T. Uemori, A model of large-strain cyclic plasticity describing the Bauschinger effect and workhardening stagnation, Int. J. Plasticity (2002). Vol. 18, pp. 661-686
3. CEM Inst Co., MatPara Users Manual. http://www.cem-inst.com/
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5. Red Cedar Technology, Inc., HEEDS Professional User's Manual (2009). http://www.redcedartech.com/