The Advanced Die Design System™ from UES, Inc. Featuring the Intel iPSC™-VX System

DESCRIPTION

The Advanced Die Design System™ (ADDS™), a comprehensive CAE system for the die design needs of the metal forming industry, was developed by Universal Energy Systems, Inc. (UES) on behalf of the U.S. Air Force Materials Lab at Wright-Patterson AFB, Ohio.

Using ADDS, complex dies can be designed much faster and at much lower cost than with traditional methods. ADDS replaces slow expensive prototype testing with computer simulation of die performance using the ALPID metal deformation process simulator. This approach represents the only practical method for designing dies intended for exotic alloys and composite materials. The Advanced Die Design System is an easy to use, revolutionary problem solving tool for the entire die design process.

The ADDS system hardware consists of a graphics workstation tightly coupled to the iPSC™-VX system. The ADDS design environment uses knowledge-based workstation software to manage the interactions between the user, the die design tools, and the ALPID process simulator. One iPSC-VX system can be shared among several die design workstations as a high-speed, multi-user ALPID application engine.

CAPABILITIES

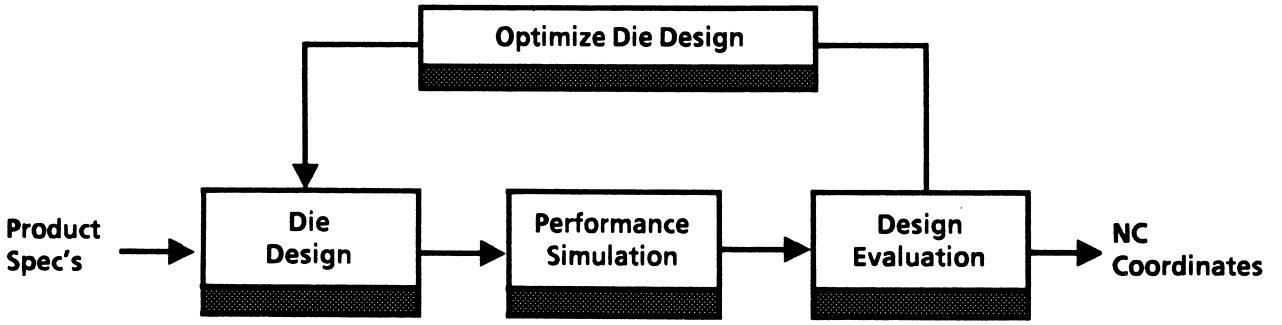
The first release of ADDS supports extrusion die design and 2-dimensional ALPID process simulation. The die design rules used by ADDS enable an inexperienced designer to determine die characteristics including size, shape, and type. The system's materials modeling data base provides further assistance by specifying optimal workpiece processing parameters for correct internal microstructure and external finish. The designer verifies the correct die cavity size and shape, and the correct size, number and placement of openings by simulating die performance with the iPSC-based ALPID simulator.

Planned enhancements to ADDS will support 3-dimensional ALPID simulations for extrusion, forging, and other metal forming operations. Applications for the Advanced Die Design System include:

- **Aerospace** Billet conditioning; body and frame structural parts such as stringers, spars, etc.
- **Appliance** Seamless tubing, collapsible tubing, heat exchangers, containers, casings, frames, etc.
- **Construction** Structural components, curtain rods and tubes, casings, sills, thresholds, etc.
- **Automotive** Structural parts, trim, shafts, axles, cylinders, bushings, bearings, pinions, gears, etc.

SYSTEM FEATURES AND DESIGN METHOD

Design starts with specifications for part geometry and tolerances, desired internal microstructure and external finish. To create the first design, the user accesses the system's database of material behavior information and die design rules. This data base includes test results of materials behavior under stress, strain and temperature, and information on production press characteristics, billet geometries, container sizes, and lubricants. ADDS provides assistance in selecting optimal processing conditions and parameters for finite element process simulation.



The user models die performance on the iPSC-VX parallel application engine under selected conditions with 2-dimensional ALPID, a thermo-rigid-visco-plastic finite element process simulator. ALPID includes features for handling arbitrary die geometries and remeshing and provides accurate solutions for analysis of complex material properties and boundary conditions in large deformation problems.

ALPID results are displayed as color graphs of adiabatic temperature rise, strain increment, and strain rate variation. After the performance is known, the user interactively makes changes to the design and process parameters until the optimal die is created. The final design is available as 3-dimensional coordinates for NC tool path generation for EDM electronic machining. The ADDS design method optimizes user productivity, eliminates the need for prototype testing and greatly reduces the time required to get new parts into production.

Throughout the design process, the designer is presented with a graphics-based user interface that hides the complexities of the system and its application software. The interface orchestrates interactions between users, tools, and design information, performs data maintenance and housekeeping chores, and prompts the designer with the next task sequence in the design cycle. The ADDS user does not need to be a die design expert or have refined computer skills.

THE ALPID SIMULATION TECHNOLOGY

ALPID is a finite element modeling code for analysis of large plastic incremental deformation that has been validated by the Air Force for accurately modeling 2-dimensional plane strain and axisymmetrical problems related to metal forming. ALPID has also been developed and validated to solve problems involving complex 3-dimensional materials flow. This capability will be offered as part of ADDS in a future product release along with design software for forging and casting processes. Intel's 4-processor version of the iPSC-VX, the SugarCube™, performs ALPID simulations at more than twice the speed of a VAX 8600 system costing ten times more. Larger versions of the iPSC-VX system will be required for the tremendous data storage and computational requirements of 3-dimensional ALPID simulation.

SUMMARY OF BENEFITS

- Increases user productivity
- Improves die design quality
- Improves understanding of design tradeoffs
- Reduces die design time
- Reduces die design cost
- Reduces die rework

PRODUCT AVAILABILITY

A Beta release version of ADDS with the iPSC-VX will be available in November, 1987; production shipments are scheduled for February, 1988. For further information, contact:

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