About CAPP Issues discussed in the GAMA Group

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About CAPP Issues discussed in the GAMA Group

1. Brief Presentation of GAMA Group
2. Process Planning Issue
GAMA Group - Objectives

GAMA: working group on manufacturing process planning, created in 1987 by Prof. Bourdet.

- to co-ordinate researchers and industrials, who have an interest in process planning,
- to share and build process planning issues,
- to exchange methods and results.

Domains: mainly machining, forging and assembly.
GAMA Group - Processing

3 meetings a year on a specific topic

http:www.3S.hmg.inpg.fr/ci/gama/


25 Ph.D trained in process planning
GAMA Group - Members

Main contributors

- ENSAM Metz
- CRAN Nancy
- LURPA Cachan
- IRCyN Nantes
- KADETECH
- Lab3S Grenoble
Process Planning Issue

Part definition
Objectives
Production requirements

Knowledge on manufacturing methods
Resource capability

CAPP System
Manufacturability Evaluation System

Process plan
Part definition
Production system resource and management

Manufacturing evaluation
Cost estimate
Stand alone Process Planning Systems

Knowledge on manufacturing methods

Part definition
Resource capability
Objectives
Production requirements

CAPP System

Process plan
Cost estimate
Part validation

Non-linear planning system with resource allocation and sharing (machine, fixture, tool).
Basic operation = manufacturing operation (operation conditions, resources).
Main GAMA Results

Basic methods.

• Knowledge based methods (expert system, propagation of constraints or fuzzy logic) vs algorithmic or procedural methods.

• Systematic approach vs opportunist approach.
Main GAMA Results

**Principles: Two steps solving.**

Local plans: machining feature concept

- Machining Feature
  - intrinsic forms
  - intrinsic tolerances

- Local plans
  - determination of operations
  - allocation of resources

Global plan: interactions between features

- Interactions
  - topological relations
  - geometric tolerances

- Global plan
  - operation ordering
  - resource sharing
PROPEL System

- Part description (machining features)
- Resource description (machines, tools)
- Extraction of fixturing features
- Association of plans to every machining feature
- Process plan in progress and history
- Part plan based on interactions between features

- begin
- end

- machine-tool level
- fixture level
- cutting-tool level
- basic action level
Stand alone Systems: new Issues

To carry on the work done in process modelling by

• Testing new technologies to solve process planning.
• Formalising new manufacturing methods.
• Developing process planning methods for new domains: Rapid Prototyping, Disassembly...
Stand alone Systems: innovative Issues

Product modelling.
- From form-driven to difficulty-driven process planning.
Stand alone Systems: innovative Issues

Fixturing issue.

- management of fixturing feature choice
- properties of a correct fixturing (locating, clamping): existence, performance (accessibility, quality)
- simultaneous design of part and fixture
Stand alone Systems: innovative Issues

Deformable parts

- treatment, significant manufacturing forces (due to process)
- lack of stiffness of the part, supple part (due to part)

• Variations of part geometry
  - process strategy
  - geometry variation representation
  - geometry displacement evaluation
Stand alone Systems: planning Issues

- Gérer en de nombreuses alternatives
  ➞ différentes technologies
- Gérer des préférences
  ➞ dans les méthodes à appliquer
  ➞ dans le choix des ressources
- Gérer des compromis
- Gérer des nombres variables d’opérations
  ➞ dans les alternatives
  ➞ création et destruction d’opérations
New Challenge for Process Planning

From

Product Definition | Process Planning | Production

Product Life Cycle

to

Product Definition | Production

Process Planning

Product Life Cycle
The new Framework

Process Planning = an Activity of the Product Development System

• a design activity
  ➜ problem with uncertainty vs well-defined problem
  ➜ design parameters vs process parameters

• in a network
  ➜ new industrial organisation
  ➜ new product development methods
Integrated Process Planning

Knowledge on manufacturing methods
Resource capability

Partially defined part
Objectives
Production requirements

Manufacturability Evaluation System

Process plan
Part definition validation
Design modification
Additional definition of the part

Manuf. system resource definition
Production management
Manufacturability evaluations
New industrial Issues

To perform Concurrent Engineering.
- New time = Gain (parallelism) - Loss (exchanges)

early \rightarrow co-ordination

New methods for product and process engineer work
New industrial Issues

To increase sub-contractor competence.

From

Part drawing
form
tolerance

Process plan
operations
resources

to

Product function
performance
constraint

Process plan
operations
resources

Part definition
form
tolerance

Part and process optimisation from product functions
New industrial Issues

To optimise product and manufacturing system.

- Change in product definition
- Change in process definition

Performance requirement
Capability of the process

Level of flexibility of parameters
Product - process indicators
Procedures to introduce quickly emerging technologies

Mutual constraints on product and process
New scientific Issues

Product Development Process

➡ mechanisms of co-ordination.

From Tichkiewitch

D.B. Laboratoire Sols Solides Structures, Grenoble, France
New scientific Issues

Synthesis CAPP systems

- constraint formulation
- geometry creation
- indicator of control
- decision making mechanism
- level of flexibility of parameters
- synthesis of tolerance
- risk evaluation
New scientific Issues

Product Modelling

→ product models suiting product - process co-operation

From Eversheim
Product Model and Synthesis CAPP Systems

**Functional features (skin features)**
E1, E2: planar faces and tapped holes
E3, E4: planar faces
C5, C6: forbidden spaces
C7: authorised space

**Functional conditions**
R1: perpendicularity E1 E3 tol. 0.03
R2: distance E1 E2 tol. 0.4
R3: distance E1 E2 tol. 0.2
R4: perpendicularity E2 E4 tol. 0.3
R5: distance E3 E4 tol. 0.04

**Skeleton feature**: ___

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From Brissaud
Planning avec des entrées variable ou incomplètes

- les variables de production changent
- la définition de la pièce change
- variations en cours de conception
  - sensibilité du plan à ces changements
  - flexibilité des paramètres

- incertitude sur le problème
- relier les paramètres du plan avec les paramètres de définition du produit