Using Spatial Features to Annotate 4D Movies

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Outline

- practical motivation
- point of departure
- research goal
- research challenges
- methodology
test case

- Campus buildings
- $34 million
- Costly roof construction problems
- Use test case to illustrate examples and highlight problems with current scheduling

generating a schedule

Project Goals:
1. Finish Roof for Waterproofing
2. Identify Potential Problems
3. Optimize Cost, Safety, Risk

How would you schedule?
visualizing a schedule

Gantt Chart Diagram Method

Visualize Construction Schedule of Roof

schedule tool

evaluating a schedule

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Gantt Chart View of Schedule

Evaluate the Schedule

go ahead or re-plan

collection team

how do you evaluate the schedule?
traditional schedule process

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Activity Object for "install gutter"
**undiscovered problems**

- no support for gutter at time of installation
- tiles were damaging roof
- stucco was cracking

**re-planning issues**

- what kind of assembly to add for connection
- who installs piece
- who uses scaffolding and when
- when to install new connection piece
- how to prevent damage to stucco
4D modeling process

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4D modeling process
4D modeling process
4D modeling process

4D Simulator

July 14, 1997

install
insulation
install
cuiture
install
water
drainage

4D Activity
Object for
"Install gutter"

what
acts on

install
gutter

performed

where
space

perform

when
day 4
after insulation

is a

action
type
point of departure

- evaluating current schedules relies too much on planners
- current and 4D visualization do poor job of communicating "who", "what", "where" and "when" and schedule constraints
- still need to contextualize criteria with construction schedule

research goal

- provide better visual representation of schedule criteria
- use 4D context as starting point-time and space, relate everything to this
- component-centric view of construction
research goal
research goal

install gutter

what gutter acts on
constrains

4D + x Model Activity Object for 'install gutter'

where space
performed

who sheet metal sub requires
nails

when day 4 after insulation
performed

is_a action type

research challenges

4D + x model with schedule criteria

4D Movie method with Annotation

Visualize Construction Schedule of Roof

4D tool

Annotated 4D Movie
research challenges

4D analysis rules/methods

4D +x model

analyze construction schedule

4D +x model with schedule criteria

4D analysis tool

what is “x”

any information that can be related to 4D content of 3D-CAD components and construction activity that is used to generate schedule criteria, including constraints

component attributes

inter-component relationships
example of “x”

- Who: sheet metal sub. not’s
- When: day 4 after insulation
- What: gutter
- Where: space

install gutter

productivity

temporary support

potential damage

optimal resource

project goals

$  

constructability

safety

example of “x”

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4D product component

component attributes
Inter-component relationships

how do we get “x”? 
- component library
- derive by algorithm
- assign relationships and attributes
- design and schedule with "features"
task 1: select a component

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task 2: select the type of feature
task 2: select the type of feature

![Diagram](image1)

task 3: associate feature with component geometry

![Diagram](image2)
annotation is a note added for explanation or comment

4D annotation visually explains the results of a 4D analysis
other kinds of annotation

- Show delta between alternatives
- Cost analysis

what is a feature

Abstract definition

a generic shape which carries some engineering meaning

SME

feature is an object that relates particular form objects to function objects and behavior objects
inspiration from mechanical domain

general definition

any entity used in reasoning of design, engineering and manufacturing

[C A M -I90]

a semantic grouping used to describe a part and its assembly. It groups in a relevant manner functional, design and manufacturing information

• for design
• for generating assembly sequences
• specific to part
• nomenclature of “machining, assembly features”
• mapping between feature and machining operation
• classifications of features
research challenges

are features generalizable?
  are there other examples we can use
  features for generating and
  visualizing criteria

can we formalize features for construction?
  can we develop a feature taxonomy
  for construction

research challenges

is visualization of criteria in 4D context valuable?
  what kinds of information do
  planners really need to see and can
  they learn a new language

can we develop a visual language
  for schedule criteria?
  are features the only necessary tool
  for producing these visualizations
Can features be used to generate this information? If not, can the same approach be applied?
research methodology

Annotation Techniques

4D + x with schedule criteria

Visualization Schedule

4D Annotator

4D annotated movie

Test alternative ways of viewing schedule criteria

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feedback?

what information is useful for schedulers?

can you envision application of such a tool?

how to validate?

feature taxonomy for construction