MatDL: Making Connections between MSE Education and Research

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Transport Archive and Course Composer

Transport Phenomena Archive
- Initiated by MIT
- Includes teaching resources:
  - Problems/exercises
  - Handouts & courseware
- Allows modifications & additions
- International editorial board
- Metis workflow technology (CU) for review process
- Initial content for testing course composer

Course Composer
- Enables flexible reuse
- Content selection:
  - LOM metadata
  - Graphical ontology
- Content adaptation:
  - Transcode
  - Compose
  - Output document

Problem/Exercise

Transport Resource Viewed in MatDL

MatML and Material Graphe

Materials Markup Language (MatML) is an XML-based language for exchange of materials property data

Currently:
- Few available MatML example resources
- Few examples using MatML with applications

Goal:
- Provide complete example in educational context
  - Tagging materials property data with MatML
  - Parsing MatML
  - Using data in software application
- “Real” data for realistic learning experience

MatML Example: Selected Properties of Ti

Materials Property Sheet

Student developers:
- Kyle Stein (KSU)
- Jorge Vieyra (MIT)
Abstract

A primary goal of the Materials Digital Library (MatDL) is to bring materials science research and education closer together. MatDL is beginning to realize that goal by serving as an intersection for content, tools, and use among academe, government, industry, and the international community. MatDL is collaboratively developing a course composition tool (KSU), a submission tool (KSU and U-M), and a materials property grather (KSU and MIT). An international editorial board is being assembled to review new contributions of teaching materials to the MatDL Transport Phenomena Archive using Metis workflow technology developed at CU. Archive resources, described with DC and LOM metadata, serve as initial content for testing the course composition tool which enables flexible reuse based on user selection criteria and dynamic topic weighting. The submission tool has been integrated into the regular workflow of U-M students and researchers generating nanostructure images. It prompts users for domain-specific information, automatically generating and attaching keywords and editable descriptions. MatML is an extensible markup language for exchanging materials information developed by materials data experts in industry, government, standards organizations, and professional societies. The web-based MatML graper allows students to compare selected materials properties across approximately 80 MatML-tagged materials. The MatML graper adds value in this educational context by allowing students to utilize real property data to make optimal material selection decisions. MatDL is also making available to interested students and researchers Python codes (FiPy) developed at NIST that use the finite volume method to solve partial differential equations and generate images.
**Submission Tool for Soft Matter Nanostructures**

**Goal:**
- Ensure adequate level of detail & consistency
- Organize results for intelligent access and storage

**Strategy:**
- Provide drop-down selections & specific prompts
- Automatically generate keywords & description from responses

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**Final Submission Viewed in MatDL**

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**Modeling and Simulation Tools**

**A Finite Volume PDE Solver Using Python (FiPy)**
Jonathan E. Guyer, Daniel Wheeler & James A. Warren
Metallurgy Division

**FiPy Overview**
- FiniteVolume code for solving coupled sets of PDEs
- Code currently addresses Phase Field models
- Code will be freely available
- Large archive of test problems
- User controls program flow

**FiPy Design - Objects**