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Process system integration

Jelenka Savkovic Stevanovic

Faculty of Technology and Metallurgy Belgrade University, Karnegijeva 4, 11000 Belgrade, Serbia

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Abstract. Process engineering today is concerned with the understanding and development of systematic procedures for design and optimal operation and control of the chemical process systems. This work motivated by the need to provide a more flexible than existing approaches framework for changes in chemical process engineering in particular, and for predicting the behavior of process systems in general. Integrated method of the process systems development make possible seeking out the most adequate model for simulation of real process design and optimization, that leads to improving current and development a new processes. The study state plant simulation model and dynamic simulation model make significant tools for observation behavior of the process. Comparative study of different processes can established more concurrent process alternatives.

Keywords: Process system, models, design, operation, skills, teaching.

I. Introduction

This paper proposes an approach to learn chemical process systems. Knowledge representation has always been central topic research identify there presentation scheme of logic, procedural representation, semantic networks, production systems, direct analogical representations, semantic primitives, and frames and scripts [1]. Logic is too powerful because the need to acquire knowledge automatically from teacher or environment and integrate it with what is already knows. A representation of facts or rules only becomes knowledge when used by a program to behave in a knowledgeable way.

Current process acquisition systems perform routine housekeeping, permit rote learning of explicitly presented facts, and are able to elicit from experts simple rules based on the attributes. Methods of concept learning may be able to overcome these imitations, although the present state of the art is primitive and suggests ideas rather than well developed algorithms for the knowledge acquisition tool box.

Concept learning systems take examples and create general descriptions, often expressed as rules, which process systems need [2]-[5].

In this paper process system modelling generates procedural, and rule based form a goal based architecture which further supports the development of secondary goals.

II. Process system formation

It many years since process modelling become an advanced tool for design work in many companies. Process plant model objectives include to provide a comprehensive report of materials and energy streams, determine the correlation between process units study the formation and separation of byproducts and impurities, support preventive maintain by tracking performance of key equipment over time and its relation to the buildup of impurities [6]-[9].

Impurities in raw materials, incomplete conversion, byproducts, catalysts, auxiliaries, and secondary reactions as well as process energy make production residues. To understand the reason for the formation of residues in the chemical production processes, and to understand the possibilities for modifying these processes, the general conditions for chemical reactions must be considered [1].

2.1 Intermediate products:

$$Raw \quad materials \rightarrow X + S_1 + I_1 \qquad (1)$$

2.Main product:

$$X \rightarrow P + S_2 + I_2 \qquad (2)$$

3. $S_2 \rightarrow X + S_3 + I_3$ (3)

where P is the main product, X is an intermediate product, S is secondary products, and I is designated impurities, each of which can include a variety of components such as I_1, I_2, I_3.

As an example, an equilibrium reaction is considered in which a starting material A reacts with a reaction partner B to give a product P.

$$A + B + N \xrightarrow{M,C.H.E.} P + P' + P'' + N' \qquad (4)$$

where A is the starting material, B the reaction partner, N secondary constituent of A and B, N' is the reacted secondary constituent, M is the reaction medium, C is a catalyst, H is an auxiliary, E is the energy, P is the product and P', P'' a side product or byproducts.

The term residues denotes all components that take part in the reaction and do not give the desired end product P.

2.2 Modelling support

As a step toward a complete knowledge representation scheme for modelling support, it has combined the decomposition, taxonomic and coupling relationships in a knowledge representation scheme called the system entity structure. The elements represented are motivated, on the one hand, by system theory concepts of decomposition, how a system is hierarchically broken down into components and coupling how these components may be interconnected to reconstitute the original system. On the other hand, systems theory has not focused on taxonomic relations, as represented for example in frame hierarchy knowledge representation schemes.

The segregation of the databases and knowledge base systems in the process system allows us to organize the different models and domain expertise efficiently because each of these components can be designed and modified separately. The system approach permits the evaluation of feasibility and global plant integration, always for a predicted behavior of the process dynamic systems.

Simulations of the chemical process systems are more effective because of power to make possibilities to knowledge keep on with changeable technologies, products and the other sources. In the other hand simulation by models is increasing relation teacher and student, and stay with student during whole course and further, makes shorter training time and increasing learned skills level. An approach refers to the technique which predicts the possible qualitative behaviors of a system on the basis of the model comprising the predefined transfer parameters and constraint predicates. The quantitative approach to modelling and inference involve computing the path coefficients between the variables and using the resulting equation to predict the change in the cause. Although the quantitative approach has proven very useful for dealing with many real-world problems, it is neither sufficient nor necessary under some circumstances. Furthermore, because in reality, there may not exist enough quantitative knowledge to permit full quantitative modelling, abstract qualitative models are worthwhile to explore.

III. Method of process system education

Area concerns the cooperation and pedagogical skills of the teacher is very important. It is not possible, to supply a comprehensive set rules to determine which concept learning scheme to use, given desire concept and example representations, background knowledge available, form of teacher interaction, and appropriate biases for concept representations. This paper leads suitable choices by providing examples of particular kinds of system.

Faced with practical problem, the first decisions to make are how to represent concepts and examples. Suitable forms of concepts representation will be dictated by the requirements of the process based system and the kind of examples available. Sometimes the example representation dominate the decision, while in other situations the desired concept format will force examples into a particular mode.

Logical representations are indicated by the predominance of logical relationships in example or concepts. The possibility of using attribute values strongly suggests the simpler prepositional calculus representation. Similarity based system methods are appropriate when many examples are available, or when it is not possible to define a domain theory in advance. If concept must be built on earlier learned ones, a hierarchical method is indicated. If a domain theory is known, then an explanation or discovery based system can utilize it.

Given a set of objects that represent examples and counterexamples of concept, a similarity based learner attempts to induce generalized description that encompasses all the examples and none of the counterexamples. Interesting general issues include the conditions under which the procedure converges to a single description, weather the system can know that it has converges, whether the final concept may depend on the order of presentation of examples, and whether the training sets expected to be exhaustive or representative.

The version space approach to concept learning transforms the inductive problem of generalization into a deductive one by circumscribing the way in which descriptions are expressed and searching for ones that fit the examples given. It postulates a language in which objects are expressed. If given asset of positive and negative examples of a target description, a simple search algorithm exists that finds all descriptions that are consistent with the examples. This set is called the version space.

The method applies simply and directly when each object is described by a fixed set of properties, usually represented as an attribute vector, which is equivalent to a description in propositional logic. Its performance in such domains has been studied extensively. Allowing disjunction in the description language causes the version space to explode, while even with purely conjunctive concepts, one version space boundary can grow exponentially in the number of examples.

In structural domains, each example comprises a scene containing several objects, expressed in predicate logic. Part of the problem in matching a scene with a structural description is determining an appropriate mapping between objects in the scene and those specified in the description. This mapping will have different interpretations depending on whether the scene is to compromise or merely to contain the desired object. Several theoretical results indicate that, even in the simplest cases, extreme computational complexity can be involved in working with version spaces of structural objects.

In the case of a tree, the root specifies an attributte to be selected and tested first, then depending on its value subordinate nodes dictate tests on further attributes. The leaves are marked to show the classifications of the objects they represent. For two class problems these are simply »positive«or »negative«, but it easy to distinguish more than two classes. The algorithm uses an information theoretic heuristic to find a simple tree which classifies all examples given [3].

When presented with noisy data, it construct huge decision trees which reflect the detail of every example seen. In the case of production rules, the training set is used to construct a set of rules which can be interpreted by an expert system in standard forward or backward chaining manner. While any decision tree can easily be converted to rules, the rules may contain redudances which can be eliminated by generating them directly from the examples.

It would be attractive if learning systems could build upon already learned and use them as components in newly constructed descriptions. This might allow learning to be sustained over an extended period of time, insteaded of being done on a one off basis.

A system learns hierarhical structure of concept tree. Given an example it searches for ways to express it in terms of known concepts. Insteaded of awaiting further examples from the teacher to constrain its choice of expressions, however, it selects a tentative description, synthesizes a crucial object to determine if that description is a correct generalization, and asks whether it too is an example of the concept. If so the tentative desription is accepted and attempts are made to generalize it further. If not, the tenative description is specialized to rule out the negative example and a new crucial example is synthesized.

Thus a sequence of generalizations and specialization is made, each being tested by asking the teacher to classify a crucial examples. When all possibilities for generalization have been exhausted, the description is stored and the teacher is asked for description, synthesizes a crucial object to determine if that description is a correct generalization, and asks whether it too is an example of the concept.. When all possibilities for generalization have been exhausted, the description is stored and the teacher is asked for another example of the concept.

An extreme case of nonhierarhical representation is where each object is represented by an attribute vector as a semantic network. Real world knowledge bases are likely to fall between the extremes of hierarhical and completely flat representations. It has been extended to deal properly with such situations by thoroughly investigating competing hypothesis at each stage. If such an object does not exist, the alternative hypotheses are investigated to discover the most general valid desription.

It is often argued that an explanation driven process is essential for reasonable generalization. Correlation derived purely from empirical observations are much less convincing than a theory which explains them. The earliest example of explanation based learning, learns problem solving heuristics in the domain of symbolic integration. It usualy presumes the existance of a strong domain theory in which proofs can be constructed that show why a particular example is valid but some experiments have been reported with a kind of explanation based learning supported by very weak theory in the realm of physical causality for evereyday events.

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IV. Process plant model

Process plant model should mirror the behavior of a complex plant subject to constraints in feedstock, products, equipment capacities, operational parameters, and utilities consumption. It's objectives include to:

- Provide comprehensive report of material and energy streams;
- Determine the correlation between the chemical reactors and separation systems;
- Study the formation and separation of byproducts and impurities;
- Improve in robustness to operation;
- Asses how to eliminate wastes and prevent environment pollution;
- Evaluate flexibility to changes in feedstock or products;
- Validate process instrumentation and enhance process control;
- Update process documentation and prepare
- Future investment, and
- Optimize the economic performance of the process.

Modelling and knowledge based simulation can integrate steps required to chemical process development. The general framework presented here on the model development side, the issues of knowledge representation in the form of systematic composition, ontology, and quantity representation was involved. On the model analysis side issues involving the automatic evaluation and presentation of simulation results.

In the analysis and operation of the processing systems simulation by models is a major technique [9]-[12]. The traditional simulation technique are often inflexible and provide limited means to the user. In fact, such technique can not clearly simulate the dynamic behavior of the real processes. The technological advance in simulation has addressed to research interest of simulation.

On the most widely used forms of simulation is that for operator training. So far, operator training simulators have tended to use greatly simplified models in order to ensure real time performance and most effort has been invested in the development of user interface. A further ascpect of the extended application of simulation for operator assistance could well be achieved in conjunction with software systems.

The steady state model, which is simpler to build, and has a wide variety of applications in its own right, it can be used directly in revamping and a wide variety of other engineering projects. Dynamic simulation is a process engineering tool that predicts how process and its controls respond to various upsets as a function of time [13],[14].

V. Design, operation and optimization

In design, attention focuses on the main elements of material and heat balances, on equipment investment, and more generally, on process economics. While a deeper systems analysis of the plant would be worthwhile, considering that the basic design could be responsible for more than 80% of the cost of investment and operation, a detailed simulation and constrained, however, by the project schedule and lack of data. In design phase, flowsheetings are derived.

In fact, in flowsheeting only need an accurate description of the transformation linking the input the output of the process systems (Fig.1). Interlinking and crosslinking connection are very important.

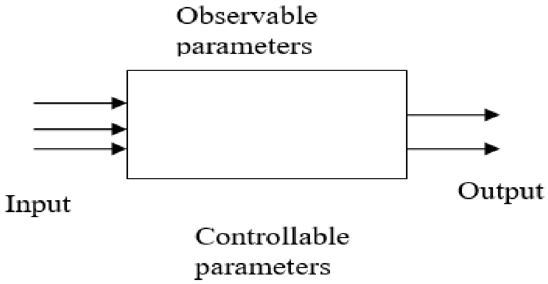

Fig.1 An process system element

In operation, attention centers mainly on product flow rate and specifications, but also plant troubleshooting, controllability, and maintenance. The performance of reactors and separators systems impose the rules of the game. They are independent and time variable to some extent. Only a detailed plant simulation enables an understanding of these interdependencies process knowledge of a detailed material and energy balance is by far more important in operations than in design. Even the flow rates of trace impurities are relevant, because they may impact equipment maintenance and environment protection. The material and energy balance as well as operational characteristics of a plant are highly interconnected, and well suited for a system analysis.

The plant simulation model should mirror the behavior of a complex plant subject to constraints in feedstock, products, equipment capacities, operational parameters, and utilities consumptions. The life cycle concept may lead to a reliable and maintainable tool.

Optimization in design specification was achieved. Using min-max principles and global optimization method the engineering economic objectives were provided.

Finely, process reliability and safety analysis need to be evolved in engineering education.

VI. Conclusion

Using available model, it is possible to produce tool that will permit us to learn or even mirror the process behavior under different operating conditions or with different raw materials and product specifications. Such as tool can be the steady state plant simulation model or dynamic simulation model which leads benefits during plant start up.

Education procedure which using a process system modelling and simulation method for optimizing design and operation was studied.

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