

COST

Preliminary Proposal For a new COST Action

Scientific Content

Title : FOOD VALUE CHAIN IMPROVEMENT USING AN INTEGRATIVE SIMULATION APPROACH FROM THE UNIT OPERATIONS LEVEL TO THE SUPPLY CHAIN LEVEL

Abstract (1000 words)

Our goal is to establish the network as a worldwide reference on a new integrative vision for simulation modelling of different stages of food production and distribution. Excellent research teams in the EU working on these challenges are using different tools and approaches which we propose to analyze in an original multidisciplinary way of thinking. Although many models are relevant for quality improvement, customer satisfaction and costs reduction, they often only studied one component of the food value chain. This “traditional” and dominating epistemological approach called reductionism has failed to make significant progress in the study of such complex chain. We propose a paradigm shift in the understanding of this complexity seeking an integration of simulation techniques and proposing a hierarchical approach of the food production-distribution chain performance.

Key Words (open format, 400 characters): Food value chain, food quality, supply chain, unit operations, food distribution, hierarchical modelling, integrative simulation, combined discrete-continuous simulation, hybrid simulation,

Preferred COST Domain: Food and Agriculture

Text of proposal (maximum 1200 words):

BACKGROUND

In order to provide better quality of service at lower cost and to guarantee quality and food safety, scientists have to continuously develop methods to improve food production, technology and management. Present approaches are frequently based on empirical and experimental research methods and static methods. It is often following the observations of the production processes and organisation that research laboratories develop prototypes for testing new manufacturing processes or more efficient distribution systems. The recourse to modelling and computer simulation for these applications, is more unusual but common in fluid mechanics and continuous or discrete automatics. Nevertheless, thanks to the continual development in modelling and computer simulation tools with more powerful algorithms and 3D ergonomic interfaces, these tools appear for a myriad of applications in food and bio-industries: food technologies, food sciences, food management (traceability, food safety).

However, because of the complexity of the food value chain (information system and material flows) and the multiplicity of actors (manufacturing, distribution, services), simulation and optimization models are often adapted to each part of the chain (cf. reductionist approach) and are often disconnected from each other.

An interdisciplinary joint European effort which combines expertise in fields of food transformations and food economics is needed to clarify the complex behaviours of the material flow in different stages of the food value chain. Research teams in the EU who are working on this problematic using simulation, are difficult to identify. Most of them are only interested in the computer science aspects without particular attention on applications areas, such as food quality and food engineering. Only a few research teams are working in our field by using modelling and simulation as a methodology and a tool for improving food production and quality for final distribution to the consumer.

Just like the recent trends in integrative biology modeling considering that the reductionist approach has failed to make significant progress in the study of complex systems, we choose to study the food value chain by incorporating many perspectives bringing together a diversity of disciplines that complement one another to unravel its complexity. Firstly, we will focus on an integrated approach by using an original hierarchical approach (from the unit operation level to the food supply chain level). Secondly, having noticed that simulation applications are often developed for the simulation of continuous-time, discrete-time or discrete-event models and that the nature of the food value chain is neither completely discrete nor continuous, we propose to study combined simulation models thanks to object-oriented techniques capabilities on a very high level. Working on this original research topics by sharing techniques and methodologies at the EU level, should build on and reinforce already ongoing research activities in different research teams and contribute significant added value to these and to the field of integrative simulation and combined simulation models. Finally, important benefits for analysis and designing food processing and distribution systems can be expected thanks to this COST Action centred on a new advanced way of thinking the food value chain.

OBJECTIVES

The first objective will be to analyze simulation modelling of complex processes of food transformation (physico-chemistry, operations management) and distribution (supply chain management). In order to improve food quality, to provide consumer satisfaction and to reduce operating costs, the second objective is to introduce a new integrative vision for food processing and distribution instead of the traditional mono-disciplinary approaches.

We propose to carry out an exchange of view of (1) possible overlapping of different simulation tools at different hierarchical levels (from the unit operation level to the supply chain macroscopic level) as well as (2) thinking and sharing ideas on possible trans-disciplinary mixed approaches combining continuous and discrete simulation models according to the a priori analogy made by the modeller (i.e. fluid mechanics, thermodynamics,...) and its corresponding mathematical formulation.

SCIENTIFIC PROGRAMME

In the beginning, participants will collect information about ongoing research in the field of simulation applications in food transformation and distribution and extend the present range of experts to be involved in this action.

WP1. Then, during the two first annual years, we propose organize in parallel specific technical workshops in objective to share simulation experiences tackling different stages of the food value chain. We voluntarily choose to use this common reductionist approach by sharing experiences in the objective to build a state-of-the-art of the present simulation techniques and methodologies aiming to provide better quality of service at lower cost and to improve products quality and guaranty food safety.

At the factory level, the technical workshops will concern the applications of:

WP1a- Simulating and optimizing the design of an unit operation or a process

WP1b - Simulating and optimizing the operating conditions

WP1c - Simulating and optimizing of product formulation

WP1d - Simulating and real time simulation and control

WP1e - Estimation of thermophysical properties by inverse techniques

WP1f - Simulating and condition based monitoring, Failure analysis

WP1g. Risk assessment/Exposure assessment

WP1h. Analysis of evolutive food products.

For example, WP1h pertains to true transversal research activities. Food can be formulated optimally (WP1c), but food substrates (both fluid and solid) are subject to important biochemical/functional/organoleptic issues during processing e.g. the production of acrylamide in fried products, the degradation of vitamin and the survival of bacteria during pasteurization/sterilization of liquids. The dependence of these issues upon operations is strategic.

At the supply chain level, the applications will concern:

WP1h - production management, scheduling problems, operations management

WP1i - logistics, supply chain management, performance of chains and networks

WP1j - traceability, simulation of information systems, tracking/tracing (logistics schemes) and quality assurance concepts.

WP2. The next step will consist in proposing a simulation model taxonomy and a critical analysis of the simulation reductionist approaches.

WP3. Workshops and conferences will then be organized the two last years in order to discuss about the limit of such approaches and to introduce a possible integrative approach of simulation. Integrative simulation experiences from other application fields will also be welcome as well as from non-EU countries and new ways of designing simulation models will be presented and discussed. After each conference, a selection of students and senior researcher exchanges will be proposed in order to facilitate the simulation integration works in EU-laboratories. Poster sessions will be organized to testify new experimentations implemented using hybrid and/or hierarchical simulation models applied to food transformation and distribution improvement.

Almost each one of them will use a different approach: i.e. statistics vs. numeric, ordinary vs. differential partial equations, concentrated vs. distributed modelling, etc. each WP needs internal overviews discussions as well as transversal open discussions among all WP participants discussed together by an appropriate coordinate action, in order to bring forth better science.

OVERVIEW OF THE PROJECT LINE MANAGEMENT STRUCTURE

a. LINE MANAGEMENT

a1. Network Co-ordinator and Scientific Officer

a2. Core Management Team

a3. Co-ordinating Management Committee

a4. Network Members

b. SUPPORT STRUCTURES

b1. Industry Advisory panel

b2. EU Advisory

c. OUTLINE OF PROJECT MANAGEMENT ACTIVITIES

c1. Inaugural Meeting

c2. Core Management Meeting

c3. Co-ordinating Meeting

c4. Workpackage Meetings

c5. Periodic (ongoing) Meetings

- Co-ordinator with Core management: Monthly meetings
- Co-ordinator with Co-ordinating committee: Every 6 months,
- All members with Industry Advisory panel: 6-monthly meetings
- Individual research teams: As necessary, minimum monthly meetings

The duration of the COST action is planned for four years.

Today, eleven countries already agreed to participate of this new COST action: Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, Portugal, Sweden, United Kingdom (for information since 2000,we organized every two years the FOODSIM conferences where twenty countries already submitted papers : Argentina, Algeria, Australia, Belgium, Brazil, Canada, China, Denmark, France, Germany, Iran, Ireland, Italy, Japan, Norway, Romania, The Netherlands, Turkey, Ukraine, USA).

We would like that the COST Office supports our travel expenses, finance the conference organizations, short term scientific exchanges and the promotion of this program for the next four years.