Background
The SimTech Cluster of Excellence [1] studies multi-scale and multi-field simulation methods. These methods aim for combining different scales (e.g. cells, tissue, bone, skeleton) and different scientific fields (e.g., chemistry, biology, and physics) into one overall simulation. The Institute of Architecture of Application Systems (IAAS) has built a workflow management system that is tailored specifically for the requirements and needs of scientists [2]. The workflow system allows to model simulations as workflows in order to make them more flexible and improve automation. The workflows can be modeled, executed, adapted, monitored, and analyzed. The current system orchestrates different simulation components into one workflow using either only one scale or an approximation of all scientific fields/scales onto one scale. Workflows can be paused and resumed explicitly or at breakpoints, which have been manually set. This enables scientists to experience modeling, execution, and the monitoring of execution in one tool as one coherent experimentation phase. Technically, this is realized by consuming and producing events during workflow execution via a messaging system. An event model describes all possible events and their relation [3].

In order to extend the system for handling the coupling of separate simulation workflows operating on different scales and scientific fields, we want to introduce the notion of choreographies to simulations. Choreographies are a concept of the business domain providing a global view on the interconnection of independent organizations communicating without a central coordinator. The business logic of each organization (also called choreography participants) is implemented/entailed by workflows. We use the choreography language BPEL4Chor [4], [5] to model choreographies of simulation workflows. A BPEL4Chor choreography itself is not executable but can be transformed into the BPEL workflows that represent the participants in a choreography. In the work of [6] a choreography designer, the ChorDesigner, has been developed.
Tasks
In order to support the steering of multi-scale and multi-field simulations, the ChorDesigner has to be extended. It must be investigated how the steering of running choreographies can be achieved from the ChorDesigner by starting/deploying, stopping, resuming, undeploying the collaborating workflows on our workflow engine as well as setting breakpoints in the choreography model with one click. This includes an extension of the existing BPEL event model and event messages to consider that the enacting workflows form a choreography. Furthermore, the propagation of the steering events to distributed workflow engines via an enterprise service bus has to be considered.

In this work the following tasks have to be fulfilled:
- Literature analysis of the state-of-the-art with regard to steering of choreographies in general
- Conceptual definition of choreography steering
- Extension of the BPEL event model and the event messages with choreography grouping and steering events
- Identification which parts of the SimTech prototype have to be extended
- Implementation of the concepts
- Evaluation of the implemented concepts

Required previous knowledge and experiences:
- Java programming skills
- Workflows [7]
- WS-BPEL [8], [9]

The lectures "Services and Service Composition", "Business Process Management", and the listed literature are recommended for preparation. The student has to manage his schedule including the work packages and milestones by himself. A helpful guide for planning and writing a thesis can be found in [10] and [11]. The thesis can be written in English or German.

Literature


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