



COST 526

**“Automatic Process Optimization in Materials Technology”  
(APOMAT)**

**Half-Yearly Report**

<b>1. Reporting Period</b>	<b>1.7.2003 – 31.12.2003</b>
Project title	Formulation of Objective Function for estimating Fatigue Damage of Cold Forging Tool Steels at Micro Scale
Project leader Organization	Dr. Tomaž Rodič Faculty of Natural Sciences and Engineering, University of Ljubljana, Slovenia.
Main collaborators involved	C3M

**2. Funding Situation**

Amount of money received specifically for COST  
Other resources partially used for the project

4.9 kEuros  
0 kEuros

**3. International Collaboration**

(mention group and type of work done in collaboration during the reporting period)

Participation in the Working Group Meeting in Krakow + project progress report

- YES ➔  
 NO

LMT-ENS Cachan (France) – Micromechanical modelling of materials

**4. Industry participation**

(mention name of companies and work done in collaboration during the whole project)

Iskra-Avtoelektrika. Investigations of parameters influencing service life of tooling systems

<b>5. Meetings, visits, exchange of scientists, short-term scientific missions</b>	<b>Location, date</b>
Working Group Meeting Meetings with Iskra-Avtoelektrika	Krakow, 27-28.11.2003 Ljubljana, Nova Gorica, 30.7.2003



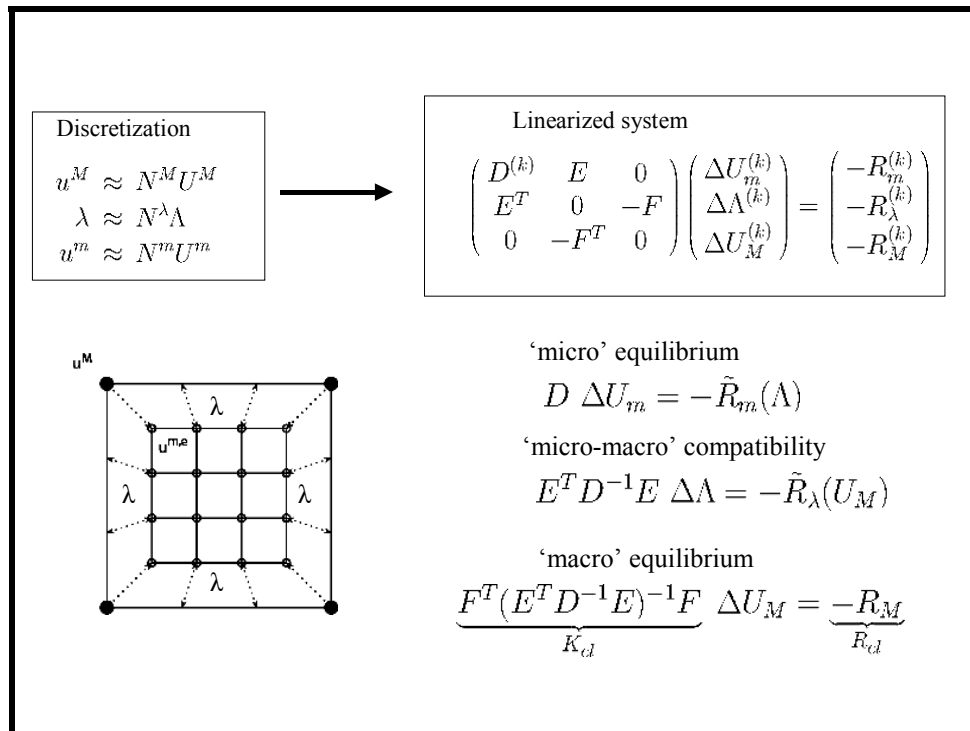
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**6. Progress within the reporting period**

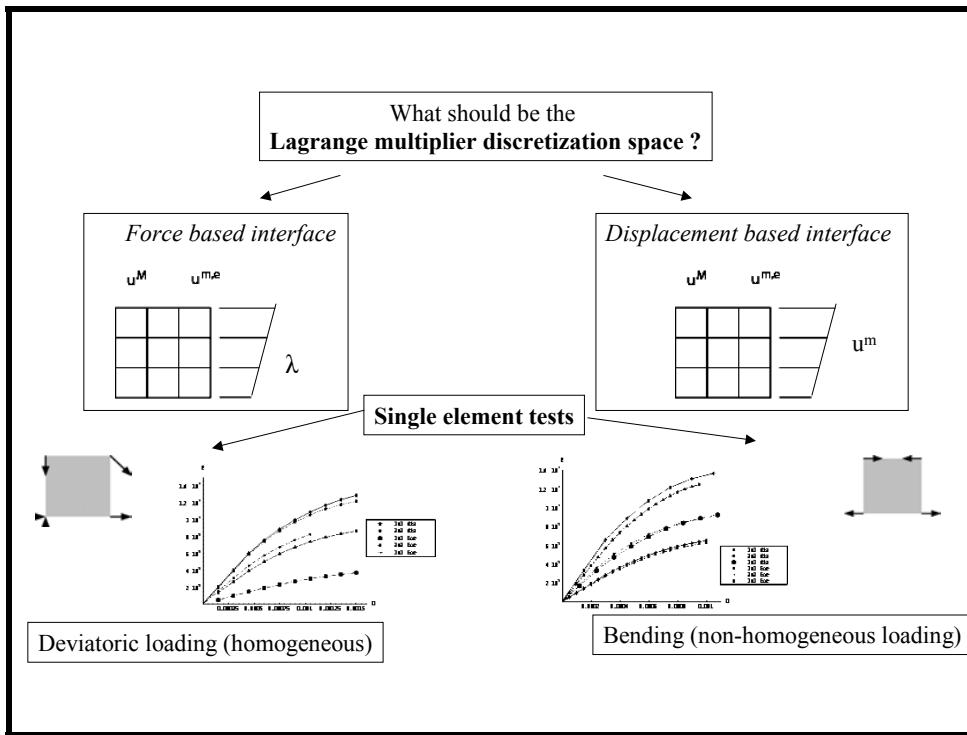
(Not exceeding 3 pages, including tables and figures)

In the progress report for the previous six-month period a strongly coupled formulation of micro-macro problem for heterogeneous structures has been presented. This scale coupling formulation is now implemented into finite element code by using the localized Lagrange multiplier variational approach. Main features of numerical implementation are outlined in Box 1. The approach has been tested for two extreme cases of Lagrange multiplier discretization, corresponding to the displacement-based and force-based interface. The results of the test are shown in Box 2.

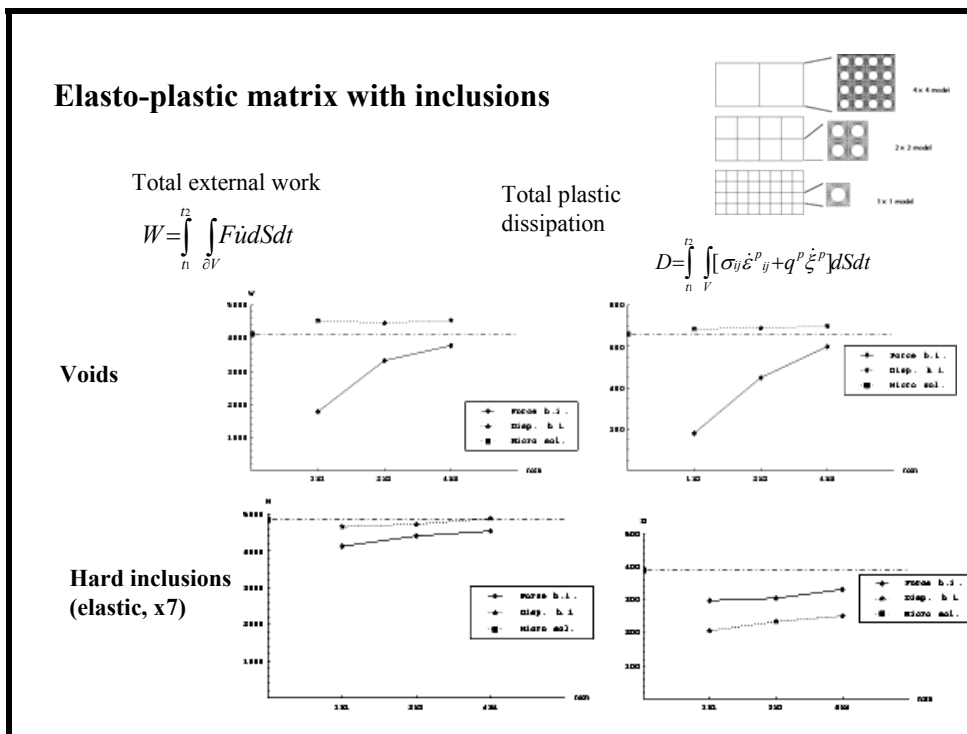
The response of micro-macro model with respect to total external work and total plastic dissipation as well as effects of finite element spatial discretization on both micro and macro scales have been assessed for elasto-plastic matrix material with voids and hard inclusions. Results of these studies are summarised in Box 3.



**Box 1.** Numerical implementation of micro-macro formulation



**Box 2.** Lagrange multiplier discretization space



**Box 3.** Lagrange multiplier discretization space