FACULTY OF ENGINEERING AND ARCHITECTURE

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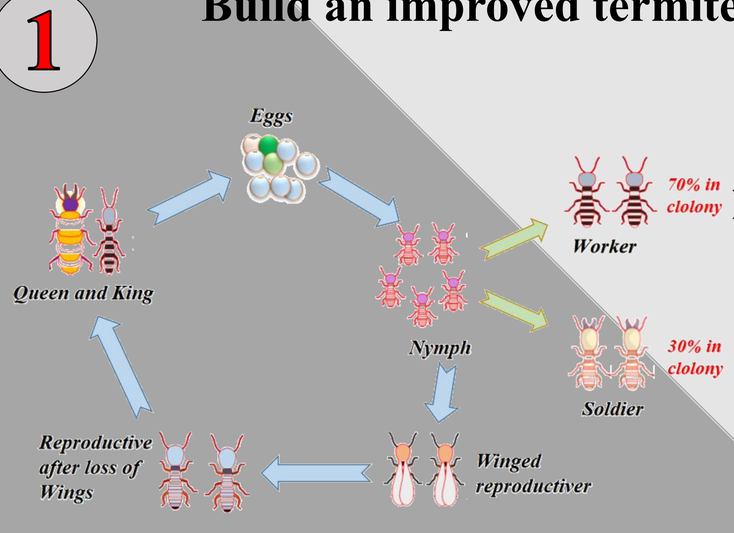
Fracture Fatigue and Wear

SOETE LABORATORY – EMSME (EA08)

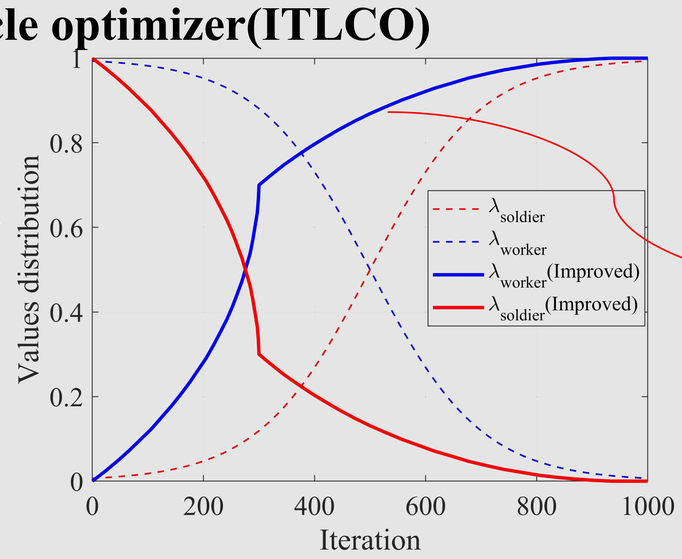
Yifei Li， Cao MaoSen, Magd Abdel Wahab

STRUCTURAL DAMAGE IDENTIFICATION BASED ON STOCHASTIC SPECTRUM EMBEDDING(SSE) MODEL COMBINED WITH IMPROVED TERMITE LIFE CYCLE OPTIMIZER(ITLCO)

1 Build an improved termite life cycle optimizer(ITLCO)



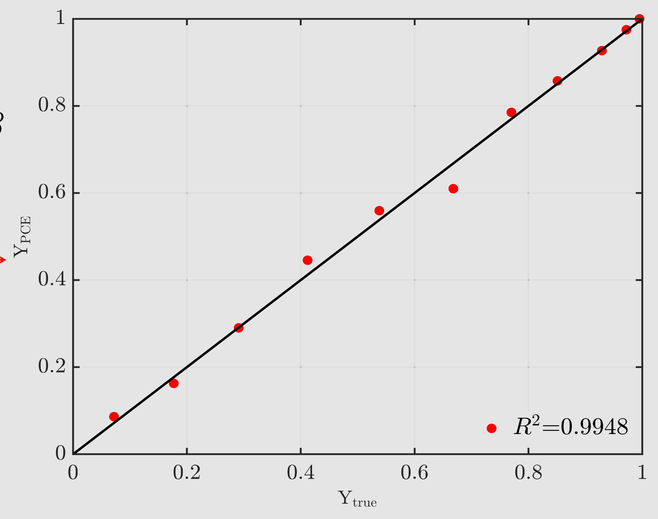
Life cycle of a Termite colony [1]



The moving functions control the times of reproductive termites' emergence in TLCO and ITLCO with 1000 iterations

$N_{initial} = 48$
$N_{doe} = 37$
$N_{val} = 11$

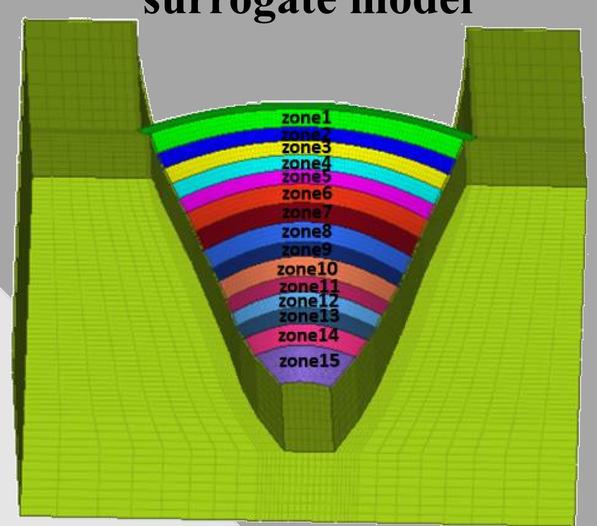
SSE



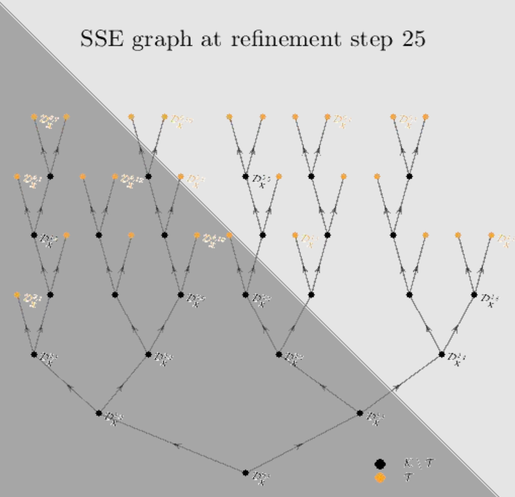
The Accuracy of ITLCO Moving Function Constructed Based on SSE

2 Construct the high-precision SSE surrogate model

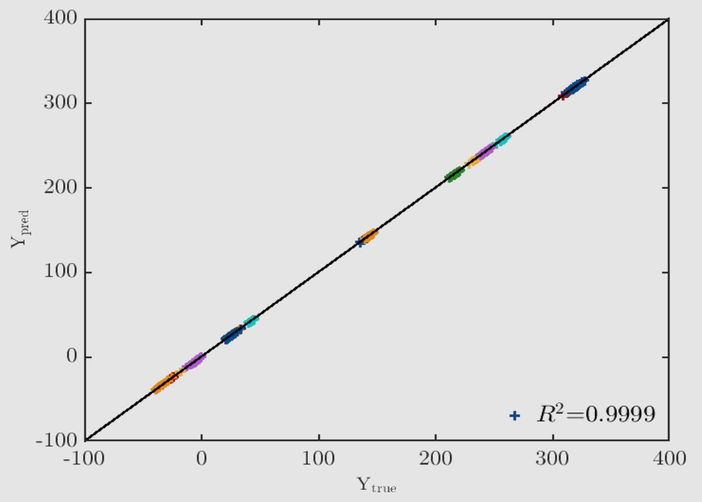
Input : *Elastic modulus for the given damaged zones in the damaged model*
Output: *Structural dynamic response (frequency, etc.) for damage models*



The assumed dam damaged model

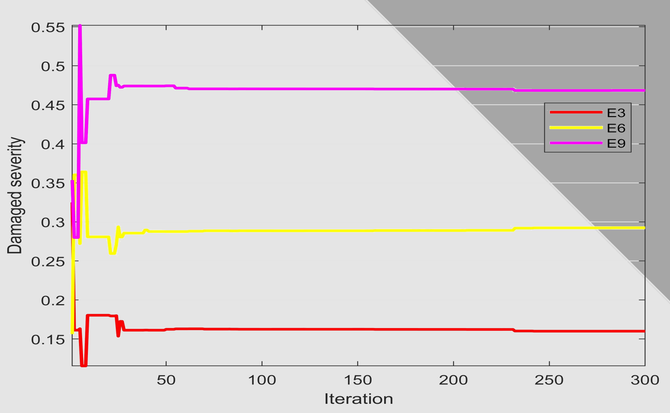


Graphical representation of the graph that stores the SSE structure.

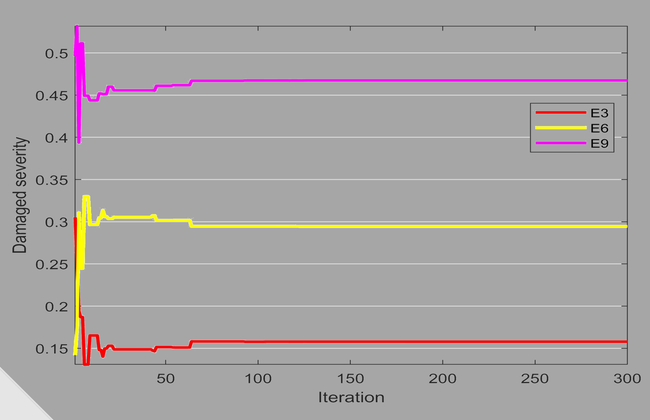


The predictive accuracy of SSE model for dam damaged model

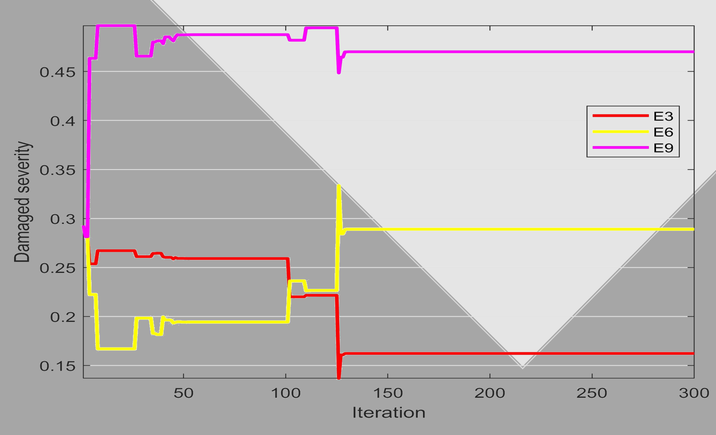
3 Structural damage identification based on ITLCO combined with SSE



The historical search of the damaged zones based on ITLCO_SSE



The historical search of the damaged zones based on TLCO_SSE



The historical search of the damaged zones based on HKOGA_SSE

< Research Targets >

Structural damage identification plays a crucial role in structural health monitoring, the model update-based damage identification strategy has become increasingly attractive. However, this strategy is usually directly iteratively solved based on optimization algorithms, and the calculation efficiency is severely restricted by the complexity of the computational model (such as the finite element model). Therefore, this study proposes a new strategy of using surrogate models to accelerate optimization algorithms to address this limitation.

Damaged zones assumption	Damage severity assumption	Relative error		
		ITLCO	TLCO	HKOGA
Zone 3	0.15	0.0524	0.0668	0.0818
Zone 6	0.3	0.0182	0.0251	0.0366
Zone 9	0.45	0.0388	0.0410	0.0448

[1] Minh H L, Sang-To T, Theraulaz G, et al. Termite life cycle optimizer[J]. Expert Systems with Applications, 2022: 119211.

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li.yifei@ugent.be
www.ugent.be/ea/eemmecs/en/research/soete
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