

# CFRAC 2023 – Plenary Lectures and Program Overview

## Tuesday, 20 June 2023

16:00-19:00 Registration and welcome drink

## Wednesday, 21 June 2023

9:15-9:45 Conference opening session  
9:45-10:30 Plenary lecture M. Wang, S. Shi, J. Fineberg\*:  
*Supershear cracks in tensile fracture: How fast can materials break?*  
11:00-12:40 Parallel sessions DDF-I, DFMS-I, FDCL-I, MSA-I, RFM-I, TF-I  
14:00-15:40 Parallel sessions CDP-I, DMMF-I, FDCL-II, MSA-II, RFM-II, TF-II  
16:00-18:00 Parallel sessions CDP-II, DMMF-II, DF-I, FDCL-III, MSA-III, RFM-III  
19:30-22:00 Concert and reception in Bethlehem Chapel

## Thursday, 22 June 2023

9:00-9:45 Plenary lecture V.S. Deshpande\*, A. Shaikeeva, H. Cui, X.R. Zheng:  
*Fracture of microarchitected solids and their anomalous toughness*  
9:45-10:30 Plenary lecture V.G. Kouznetsova\*, L. Liu, F. Maresca, J.P.M. Hoefnagels, M.G.D. Geers:  
*A multi-scale model for interfaces with a jagged deformation and failure mechanism*  
11:00-12:40 Parallel sessions CSD-I, DDF-II, DMMF-III, QBC-I, RFM-IV, TF-III  
14:00-15:40 Parallel sessions CSD-II, DFMS-II, MSA-IV, QBC-II, RFM-V, TF-IV  
16:00-17:40 Parallel sessions CSD-III, DFMS-III, FFM-I, QBC-III, RFM-VI, NRFM-I  
19:30-22:30 Conference dinner in Letenský zámeček

## Friday, 23 June 2023

9:00-9:45 Plenary lecture P. Grassl\*, C. Zhou:  
*On the modelling of fracture processes in cohesive-frictional materials*  
9:45-10:30 Plenary lecture C. Maurini\*, C. Zolesi:  
*Nucleation of cracks in variational phase-field models of fracture*  
11:00-12:40 Parallel sessions DEFE-I, FFM-II, FB-I, QBC-IV, RFM-VII, NRFM-II  
14:00-15:40 Parallel sessions DDF-III, EFE-II, FFM-III, FB-II, RFM-VIII

# CFRAC 2023 – Parallel Sessions, Wednesday, 21 June 2023

- CDP**      **Cyclic damage processes in concrete**  
organized by F. Aldakheel, M. Kaliske, G. Meschke, J. Schröder, H. Steeb, J. Storm, P. Wriggers
- DDF**      **Data, damage and fracture**  
organized by O. Allix, P. Carrara
- DF**        **Ductile fracture**  
organized by P.-O. Bouchard, J.M.A. César de Sá, R.H.J. Peerlings
- DFMS**    **Dynamic fracture of materials and structures**  
organized by I. Kožar, J. Ožbolt
- DMMF**    **Discrete models for material failure**  
organized by G. Cusatis, J. Eliáš, F. Kun, F. Wittel
- FDCL**    **Fracture and damage of composites and laminates**  
organized by P.P. Camanho, S. Hallett, J. Remmers
- MSA**     **Multi-scale analysis of damage and fracture**  
organized by M.G.D. Geers, A.E. Huespe, S. Loehnert
- RFM**     **Regularized failure models: Phase-field and other models**  
organized by L. De Lorenzis, M. Jirásek, C. Maurini, N. Moës
- TF**        **Theory of fracture, crack propagation criteria and crack tracking algorithms**  
organized by M. Ortiz, A. Pandolfi

Hall	C204	C208	C215	C217	C221	C223
Session	MSA-I	DFMS-I	TF-I	RFM-I	FDCL-I	DDF-I
Mini-symp.	<b>Multi-scale analysis of damage and fracture</b>	<b>Dynamic fracture of materials and structures</b>	<b>Theory of fracture, crack propagation criteria and crack tracking algorithms</b>	<b>Regularized failure models: Phase-field and other models</b>	<b>Fracture and damage of composites and laminates</b>	<b>Data, damage and fracture</b>
Chair	<b>M.G.D. Geers</b>	<b>V. Rubino</b>	<b>A. Pandolfi, M. Ortiz</b>	<b>N. Moës</b>	<b>P.P. Camanho</b>	<b>P. Carrara</b>
11:00	C. Linder*, P.K. Arunachala: <i>A multiscale phase-field fracture approach for rubber-like materials (keynote lecture)</i>	F. Rabette*, G. Poirey, T. Viant, A. Vandenbroucke: <i>HVEV: A nonlinear viscoelastic model applied to energetic materials</i>	F. Cianci, G. Dal Maso*: <i>Dynamic crack growth in viscoelastic materials with memory (keynote lecture)</i>	E. Maggiorelli*, M. Negri: <i>Griffith criterion for phase-field fracture</i>	A. Mitrou*, A. Arteiro, P.P. Camanho, J. Reinoso: <i>Capturing the off-axis response of thin-ply laminates</i>	O. Allix*, F. Chinesta, F. Hild: <i>Experimental mechanics and fracture: Toward a big data approach?</i>
11:20		A.M. Rajendran: <i>Shock and impact response of glass reinforced plastics</i>		Y. Chen, Y. Shen*: <i>A crack nucleation scheme for the phase-field approach to brittle fracture</i>	M. Kumar*, S. Mukhopadhyay: <i>A directed continuum damage mechanics approach to model static indentation induced damage in composites</i>	I. Hamadouche*, D.M. Seyedi, F. Hild: <i>Multiscale and multiview digital image correlation for damage detection and quantification</i>
11:40	F. Schmidt*, C. Hesch: <i>Multi-scale fracture mechanics using the FEM<sup>2</sup>/IGA<sup>2</sup> method</i>	R. Dantas Batista*, G. Anciaux, J.-F. Molinari: <i>Comparison between cohesive elements and the Lip-field approach to fracture in 1D dynamic fragmentation</i>	S. Conti, M. Ortiz*: <i>Optimal scaling laws for ductile fracture derived from strain-gradient microplasticity</i>	P. K. Asur*, K. Anam, J. Reinoso, H.E. Pettermann: <i>Revisiting size scale effects in phase field</i>	F. Daghia: <i>Dissipation at multiple length scales for improved delamination resistance</i>	A. Mishra*, P. Carrara, M. Griffa, L. De Lorenzis: <i>Modeling the cracking behavior of concrete at the mesoscale</i>
12:00	X. Liu*, J. Réthoré: <i>An efficient PCG based multigrid strategy for crack propagation simulations in heterogeneous materials using 3D images: Material properties and interface effects</i>		B. Shrimali, O. Lopez-Pamies* <i>Griffith fracture in viscoelastic elastomers done right</i>	H. Lammen*, J. Mosler: <i>An enhanced phase field-approach to cohesive fracture</i>	M. Menshykova*, T. Wang, O. Menshykov: <i>Failure analysis and optimal design of thick-walled composite pipes under combined loading</i>	S. Mpho Motsaa, G. Stavroulakis, G. Drosopoulos*: <i>Investigation of the response of masonry arches using data-driven structural analysis</i>
12:20	I. Benedetti: <i>A multiscale and multi-physics boundary integral model for polycrystalline materials including damage initiation and evolution under different loading scenarios</i>		G. Dal Maso, R. Toader*: <i>Some remarks on a new space of generalised functions of bounded variation</i>	H. Subramanian*, C.P. Rao, S.S. Mulay, C. Annavarapu <i>Coupling of phase-field based fracture propagation with healing in self-healing materials</i>	X. Ai*, B. Chen, C. Kassapoglou: <i>Structural cohesive element for the modelling of delamination between thin shells without cohesive zone limit</i>	A. Quintin*, T. Petit, R. Chocat, C. Mattrand, J.-M. Bourinet: <i>Uncertainty quantification of the reference temperature T<sub>0</sub> of reactor pressure vessel steel with experimental and numerical computation of fracture toughness tests</i>

Hall	C204	C208	C215	C217	C221	C223
Session	MSA-II	DMMF-I	RFM-II	TF-II	FDCL-II	CDP-I
Mini-symp.	<b>Multi-scale analysis of damage and fracture</b>	<b>Discrete models for material failure</b>	<b>Regularized failure models: Phase-field and other models</b>	<b>Theory of fracture, crack propagation criteria and crack tracking algorithms</b>	<b>Fracture and damage of composites and laminates</b>	<b>Cyclic damage processes in concrete</b>
Chair	<b>S. Loehnert</b>	<b>J. Eliáš</b>	<b>L. De Lorenzis</b>	<b>M. Ortiz, A. Pandolfi</b>	<b>J. Remmers</b>	<b>J. Storm</b>
14:00	M. Gimenes*, E.A. Rodrigues, O.L. Manzoli: <i>2D modeling of compressive failure in recycled aggregate concrete using the mesh fragmentation technique</i>	A. Alex*, E. Masoero, I. D. Ofițeru: <i>Carbonation in bacteria based self-healing cement: A new modelling approach (keynote lecture)</i>	C. Zolesi*, F. Vicentini, P. Carrara, L. De Lorenzis, C. Maurini: <i>Multi-axial loadings in phase-field model of fracture: Part 1</i>	S. Abu-Qbeith, M. Jabareen, K.Y. Volokh*: <i>Dynamic versus static analysis of fracture in soft materials</i>	I.A. Rodrigues Lopes, F. Danzi, A. Arteiro, F.M. Andrade Pires, P. P. Camanho*: <i>A mesoscopic model to predict ply-failure mechanisms in fibre-reinforced composites</i>	F. Aldakheel*, N. Noii, M. Haist, L. Lohaus, P. Wriggers: <i>Fatigue failure mechanism for concrete in fully saturated porous media (keynote lecture)</i>
14:20	P.H. Rios Silveira*, R. Esposito: <i>On the use of analytical homogenization for modelling of masonry</i>		F. Vicentini*, C. Zolesi, P. Carrara, L. De Lorenzis, C. Maurini: <i>Multi-axial loadings in phase-field model of fracture: Part 2</i>	J. Réthoré*, R. Seghir: <i>LEFM based criterion for crack propagation under complex structural loadings</i>	D. Kovacevic, F.P. van der Meer*: <i>Microscale modeling of time-dependent failure in unidirectional composites under off-axis loading</i>	
14:40	K. Kraschewski*, G.P. Philipot, D.M. Kochmann: <i>The fully-nonlocal quasicontinuum method: A concurrent multiscale approach to predict fracture in periodic 3D metamaterials</i>	R. Szatmári*, F. Kun: <i>Crackling noise in a discrete element model of shrinkage induced cracking</i>	P. Hesammokri*, H. Yu, P. Isaksson: <i>An experimental study of crack growth under compression using a phase-field theory</i>	G. Molnár*, A. Doitrand, V. Lazarus: <i>Crack facet initiation in pure mode III fracture</i>	T. Lenders*, J.J.C.Remmers, T. Pini, P. Veenstra, L.E. Govaert, M.G.D. Geers: <i>A micromechanical model to study the rate-dependent failure mechanisms of carbon fiber reinforced polyvinylidene fluoride</i>	D. Zhao*, M. Kaliske: <i>Mixed-mode fracture simulation by the phase-field method</i>
15:00	H. Knobloch*, S. Loehnert: <i>A multiscale analysis of dynamic fracture propagation in complex materials</i>	Cs. Szuszik*, F. Kun: <i>Discrete element modelling of the tensile failure of porous rocks</i>	R. Vodička: <i>A phase-field and interface damage model for mixed-mode fracture in materials with inclusions</i>	X. Zhai*, T. Corre, S. Brach, A. León Baldelli, V. Lazarus: <i>Crack propagation in elastic media with anisotropic surface energy: Experiments, phase-field simulations, linear elastic fracture mechanics</i>	M. Naghdinasab*, S. Aicher: <i>Progressive damage analysis of natural fiber composite laminates: A computational micromechanical perspective</i>	M. Pise*, G. Gebuhr, D. Brands, S. Anders, J. Schröder: <i>Phase-field modeling of failure behavior of reinforced high performance concretes at low cycle fatigue</i>
15:20	Z.A. Manorosoa*, A. Chrysochoos, A. Jelea, Y. Monerie, F. Perales: <i>Multiscale - atomistic/mesoscopic approach for the determination of fracture criterion in uranium dioxide</i>	M. Nitka*, M. Knak, M. Rucka: <i>Laboratory measurements and discrete element method calculations of acoustic emission in concrete beams during fracture</i>	D. Pranavi*, A. Rajagopal: <i>Modeling mixed-mode fracture in elastomers at finite strain</i>	P. H. Serrao*, S. Kozinov: <i>Characterising fracture behaviour of flexoelectric solids using newly proposed numerically robust mixed FE</i>		V. Gudzulic*, K. Daadouch, G. Meschke: <i>Mesoscale modeling of high-performance fiber-reinforced concrete under monotonic and cyclic loading</i>

Hall	C204	C208	C215	C217	C221	C223
Session	MSA-III	DMMF-II	RFM-III	DF-I	FDCL-III	CDP-II
Mini-symp.	Multi-scale analysis of damage and fracture	Discrete models for material failure	Regularized failure models: Phase-field and other models	Ductile fracture	Fracture and damage of composites and laminates	Cyclic damage processes in concrete
Chair	A. Huespe	P. Grassl	C. Maurini	R. Peerlings	S. Hallett	F. Aldakheel
16:00	D.S. Kammer*, M. Pundir, U. Angst: <i>Micro-to-macro mechanical modeling of corrosion-induced cracking (keynote lecture)</i>	M. Vořechovský*, V. Sadílek, J. Eliáš, J. Mašek, J. Květoň: <i>Mesoscale discrete model for monotonic, cyclic and fatigue loading of concrete</i>	A. Marengo, U. Perego*: <i>2D phase-field ductile fracture modeling in orthotropic paperboard materials (keynote lecture)</i>	R. Larsson*, A. Erturk: <i>Convergence of continuum damage for ductile failure processes</i>	S. Sangaletti*, A. Mitrou, I.G. Garcia, A. Arteiro: <i>Phase field fracture modelling of 3D printed materials: An anisotropic analysis</i>	R. Chudoba*, M. Aguilar, A. Baktheer, H. Becks, M. Classen, M. Vořechovský: <i>Concrete fatigue modeling and experimental characterization based on inter-aggregate cumulative sliding hypothesis ...</i>
16:20		M. Pathirage*, D. Tong, F. Thierry, G. Cusatis, D. Grégoire, G. Pijaudier-Cabot: <i>Discrete modeling of concrete failure and size effect</i>		E. Azinpour*, S.Rzepa, D. Melzer, A. Reis, J. Cesar de Sa: <i>Fracture assessment of DED manufactured FGM system using phase-field ductile fracture approach</i>		
16:40	L. Zhang*, E. van der Giessen, G. Csanyi, F. Maresca: <i>Predicting fracture toughness ab-initio: Discrete dislocation plasticity informed by quantum-accurate atomistic</i>	J. Mašek*, J. Květoň, J. Eliáš: <i>Adaptive refinement for discrete models of coupled mechanics and transport in concrete</i>	G. Bacquaert*, J. Bleyer, C. Maurini: <i>Variational formulation with dissipation-gradient regularization for softening plasticity models</i>	J. Friedlein*, J. Mergheim, P. Steinmann: <i>Gradient-plasticity vs gradient-damage for the modelling and calibration of ductile damage</i>	S. Bushpalli*, E. Graciani, B. Lopez-Romano: <i>Phase-field model for transverse cracks in composites: Effect of residual stresses</i>	J. Heinzmann*, P. Carrara, L. De Lorenzis: <i>An adaptive cycle-jump method to accelerate phase-field computations of fatigue</i>
17:00	E. Korec*, M. Jirásek, H.S. Wong, E. Martínez-Pañeda: <i>A phase-field-based chemo-mechanical model for corrosion-induced cracking in reinforced concrete</i>	J. Eliáš*, G. Cusatis: <i>Homogenized mesoscale discrete model for coupled mechanics and mass transport</i>	A.-S. Sur*, L. De Lorenzis, C. Maurini, O.S. Hopperstad: <i>A variational damage-plasticity model depending on hydrostatic stresses</i>	A. Kaniadakis*, J. P. Crété, P. Longère: <i>A XFEM-CZM based methodology for finite strain ductile fracture</i>	L.W. Zhang*, J.Y. Ye: <i>Phase-field modeling on the multi-physical damage of composites</i>	M. Hammad*, U. Nackenhorst: <i>Eigenstress-based anisotropic damage modelling of concrete at the meso-scale</i>
17:20		M. Středulová*, J. Eliáš: <i>Spherical representative volume element for discrete mesoscale model of concrete</i>	C. Stolz: <i>Moving layers and graded damage coupling with elasto-plasticity</i>	E.R. Sergio*, D.M. Neto, F.V. Antunes: <i>Fracture toughness modelling under minor crack extension</i>	A.M. Fajardo Lacave*, F. Welschinger, L. De Lorenzis: <i>Multiscale analysis of fracture in short glass fiber reinforced polymers through phase field</i>	P. Havlásek*, A. Kučerová: <i>Identifying the extent of shrinkage-induced surface cracking from the time-dependent deflections of concrete beams exposed to symmetric and non-symmetric drying</i>
17:40				B.M. Peeters, V. Rezazadeh, R.H.J. Peerlings*: <i>Lode angle effects on damage initiation in multiphase alloys</i>		

# CFRAC 2023 – Parallel Sessions, Thursday, 22 June 2023

- CSD**      **Connecting scales and disciplines to model fracture**  
organized by A. Dakkouri-Baldauf, P. Steinmann, M. Rohracker, S. Sheguftha
- DDF**      **Data, damage and fracture**  
organized by O. Allix, P. Carrara
- DFMS**    **Dynamic fracture of materials and structures**  
organized by I. Kožar, J. Ožbolt
- DMMF**    **Discrete models for material failure**  
organized by G. Cusatis, J. Eliáš, F. Kun, F. Wittel
- FFM**      **Finite fracture mechanics: Models and applications**  
organized by I. García, D. Leguillon, V. Mantič, A. Sapora
- MSA**      **Multi-scale analysis of damage and fracture**  
organized by M.G.D. Geers, A.E. Huespe, S. Loehnert
- QBC**      **Quasi-brittle cracking, coupled processes and hydraulic fractures**  
organized by I. Carol, G. Pijaudier-Cabot, G. Xotta
- RFM**      **Regularized failure models: Phase-field and other models**  
organized by L. De Lorenzis, M. Jirásek, C. Maurini, N. Moës
- TF**        **Theory of fracture, crack propagation criteria and crack tracking algorithms**  
organized by M. Ortiz, A. Pandolfi

Hall	C204	C208	C215	C217	C221	C223
Session	DDF-II	DMMF-III	RFM-IV	TF-III	QBC-I	CSD-I
Mini-symp.	<b>Data, damage and fracture</b>	<b>Discrete models for material failure</b>	<b>Regularized failure models: Phase-field and other models</b>	<b>Theory of fracture, crack propagation criteria and crack tracking algorithms</b>	<b>Quasi-brittle cracking, coupled processes and hydraulic fractures</b>	<b>Connecting scales and disciplines to model fracture</b>
Chair	<b>O. Allix</b>	<b>J. Eliáš</b>	<b>U. Perego</b>	<b>A. Pandolfi, M. Ortiz</b>	<b>G. Xotta</b>	<b>M. Rohracker</b>
11:00	J. Yvonnet*, Q.-C. He, P. Li: <i>Data-driven multi-scale modelling of anisotropic fracture-induced damage</i>	J. Vorel*, J. Vozáb, J. Kruis: <i>Numerical modelling of thermoset polymers</i>	E. La Malfa Ribolla*, G. Giambanco: <i>Strain localization in elasto-plastic beams based on a phase-field approach</i>	S. Feld-Payet: <i>Dissection of a continuous-discontinuous strategy: A review of its elementary components</i>	Z.P. Bažant*, H. Xu, A. Donmez, A. Nguyen, Y. Zhang: <i>Leapfrog in computational fracture mechanics enabled by curvature-limiting sprain as damage localization limiter (keynote lecture)</i>	M.G.D. Geers*, S.O. Sperling, J.P.M. Hoefnagels: <i>A discrete-continuum particle method for complex deformation and fracture events (keynote lecture)</i>
11:20	P. Carrara*, M. Ortiz, L. De Lorenzis: <i>Model-free data-driven fracture mechanics</i>	T. Liu*, A.S. Bhuwal, Y. Pang, I. Ashcroft, W. Sun: <i>Discovery of damage tolerant quasi-disordered truss metamaterials inspired by natural cellular materials</i>	Z. Liu*, J. Reinoso, M. Paggi: <i>Phase-field modeling of brittle fracture in large-deformation solid shells with the efficient quasi-Newton solution and global-local approach</i>	S.M. Frankl*, M. Pletz, C. Schuecker: <i>Efficient prediction of 3D crack propagation using configurational forces</i>		
11:40	E. Baranger*, G. Landron: <i>Approximation and definition of state variables for a comprehensive description of damage</i>	I.M. Wiragunarsa*, L.R. Zuhail, T. Dirgantara, I. S. Putra: <i>An efficient 3D crack propagation model using the total Lagrangian smoothed particle hydrodynamics with a frame of reference update</i>	T.H. Tuan Tran*, J. Rahmoun, H. Naceur, D. Kondo: <i>Accurate modeling of the fracture of plates using the phase-field method</i>	G. Giambanco*, M. Puccia, E. Sacco, A. Spada: <i>Crack propagation in quasi-brittle materials using a FEM-VEM tracking algorithm</i>	G.B. Barbat*, M. Cervera, H. Venghaus, C.A. Moreira, M. Chiumenti: <i>Objective numerical evaluation of cracking in quasi-brittle materials via adaptive mesh and formulation refinement</i>	F. Maresca*, V. Shah, L. Zhang, G. Csanyi, E. Van der Giessen: <i>Atomistics of hydrogen at defects towards a multi-scale, bottom-up theory of hydrogen embrittlement</i>
12:00	J. Selvaraj*, S.R. Hallett: <i>Adaptive and variable model order reduction for damage modelling using explicit time integration</i>	S. Hiemer*, P. Moretti, S. Zapperi, M. Zaiser: <i>Transition state theory based thermally activated breakdown in fiber bundles: Exact solutions and asymptotics for the lifetime distribution, average and variance</i>	M. Zaccariotto*, F. Scabbia, U. Galvanetto: <i>A unified strategy to mitigate the surface effect and to impose in a local way the boundary conditions in peridynamics models</i>	N.A. Collins-Craft*, F. Bourrier, V. Acary: <i>A non-smooth extrinsic cohesive zone model including contact and friction</i>	G. Pijaudier-Cabot*, D. Toussaint, M. Pathirage, G. Cusatis: <i>Some comments on modelling failure with peridynamics</i>	A. E. Elbanna*, M. S. Mia, M. Abdelmeguid: <i>Sequences of fast and slow ruptures on a frictional interface in an elasto-plastic solid: Application to earthquake modeling</i>
12:20	V. Kamasamudram*, L. Stainier: <i>Lipschitz regularization for data-driven computational damage mechanics</i>		J. Macías*, F. Otero, A. Arteiro, P. Camanho, J. Reinoso: <i>Analysis of the plane elasticity assumptions and the use of plasticity coupled with damage for the micro-scale analysis of composite materials</i>	J. Triclot*, T. Corre, V. Lazarus, A. Gravouil: <i>Toughening effect of out-of-crack-path architected zones by apparition of snapback instability</i>	A. Dubois*, C. Guerra, J. Scheibert, D. Dalmas, D. Bonamy: <i>Consequence of the crack tip microcracking statistics on dynamic nominally brittle fracture at the continuum-level scale</i>	A.M. Villiers*, A. Javili, A.T. McBride, P. Steinmann: <i>Configurational peridynamics</i>

Hall	C204	C208	C215	C217	C221	C223
Session	MSA-IV	DFMS-II	RFM-V	TF-IV	QBC-II	CSD-II
Mini-symp.	<b>Multi-scale analysis of damage and fracture</b>	<b>Dynamic fracture of materials and structures</b>	<b>Regularized failure models: Phase-field and other models</b>	<b>Theory of fracture, crack propagation criteria and crack tracking algorithms</b>	<b>Quasi-brittle cracking, coupled processes and hydraulic fractures</b>	<b>Connecting scales and disciplines to model fracture</b>
Chair	<b>C. Linder</b>	<b>F. Rabette</b>	<b>S. Feld-Payet</b>	<b>M. Ortiz, A. Pandolfi</b>	<b>I. Carol</b>	<b>S. Shegufra</b>
14:00	D. Addressi*, P. Di Re, C. Gatta, E. Sacco: <i>Multiscale reduced order model for the analysis of damaging masonry domes and vaults</i>	I. Kožar: <i>Load rate as a material model parameter (keynote lecture)</i>	A. Muixi, O. Marco, S. Fernandez-Mendez, A. Rodríguez-Ferran*: <i>A locally adaptive phase-field model that tracks sharp cracks</i>	C.J. Larsen: <i>Variational phase-field fracture with controlled nucleation (keynote lecture)</i>	S. Al Dandachli*, F. Perales, Y. Monnerie, F. Jamin, C. Pelissou: <i>Mixed-mode fracture of cement paste and interface under three-point bending test: Numerical and experimental investigations</i>	C. Greff*, N. Esfandiary, P. Moretti, M. Zaiser: <i>Hierarchical microstructure controls interface failure patterns</i>
14:20	G. Vu*, J.J. Timothy, G. Meschke: <i>Data-driven multi-scale analysis for early damage assessment of concrete structures using coda waves</i>		S. Khan*, I. Singh, C. Annavarapu, A. Rodríguez-Ferran: <i>Investigation of crack propagation in multi-layered media using an adaptively refined phase-field approach</i>		S. Zadran*, J. Ožbolt, S. Gambarelli: <i>Modelling freeze-thaw behavior of cementitious materials</i>	R. Paul*, P. Venkitanarayanan, S. Basu: <i>Fracture surface topology via phase field modelling: statistical aspects</i>
14:40	I.B.C.M. Rocha*, F.P. van der Meer, L.J. Sluys: <i>Bias-variance tradeoff in accelerating multiscale solid mechanics with model order reduction and machine learning</i>	V. Rubino*, A.J. Rosakis, N. Lapusta: <i>A new paradigm to study dynamic shear crack propagation and friction evolution</i>	F. Röntrop*, J. Mosler, S. Boddin, D. Knees: <i>Simulation and implementation of phase-field damage models for time-discontinuous crack evolution</i>	R. Lipton: <i>Free crack propagation through nonlocal modeling</i>	C. Biscaro*, A. Martinez, C.M. López, G. Xotta, I. Carol*: <i>Cracking and fracture of 2D and 3D concrete specimens subject to external sulfate attack</i>	M. Rohracker*, P. Kumar, J. Mergheim: <i>Comparison of irreversibility strategies in phase-field fracture simulations</i>
15:00	J. Korelc: <i>Backward mode sensitivity analysis based multi-scale phase-field modeling</i>	L. Mersel*, P. Bouda, J. Germain, J. Réthoré: <i>Phase-field numerical modelling of crack propagation through a fully-explicit time stepping method</i>	V. Klempt*, C. Krüger, S. Loehnert: <i>An extended phase-field method (XPFM) for 3D fracture simulations</i>	A. Kanan*, J. Storm, M. Kaliske*: <i>Modeling fracture of tempered glass using an eigenfracture approach</i>	L.F. Paullo Muñoz, C. Mejia, J. Rueda, D. Roehl*: <i>Coupled DDM-FEM solution applied to fault reactivation assessment in CO2 sequestration</i>	S. Dray*, A. Fau, F. Hild, T. Wick: <i>Combining damage and fracture mechanics for the identification of crack propagation parameters</i>
15:20	J. Zambrano, J. Gutiérrez, S. Toro, P.J. Sánchez, F.P. Duda, S. Serebrinsky, A.E. Huespe*: <i>Toughening effect analysis in problems of propagating cracks interacting with interfaces</i>	S.K. Kota*, B. Giovanardi: <i>Hybrid discontinuous Galerkin/cohesive zone model computational framework for dynamic fracture and fragmentation in geometrically exact slender beams</i>	J. Storm*, M. Kaliske: <i>Regularised fracture models based on representative crack elements</i>	K. Weinberg*, K. Friebertshäuser, C. Wieners: <i>Comparison of a peridynamics and a phase-field approach to dynamic fracture</i>	E. Sarris*, L. Papaloizou: <i>A fully coupled finite element model for simulating hydro-dynamical plugging of unwanted hydraulic fractures in wellbore strengthening</i>	
15:40				M.L. De Bellis, A. Pandolfi*: <i>Applications of a micro-structured brittle damage model to laboratory tests on rocks</i>		



Hall	C204	C208	C215	C217	C221	C223
Session	NRFM-I	DFMS-III	RFM-VI	FFM-I	QBC-III	CSD-III
Mini-symp.	<b>Numerical aspects of regularized failure models</b>	<b>Dynamic fracture of materials and structures</b>	<b>Regularized failure models: Phase-field and other models</b>	<b>Finite fracture mechanics: Models and applications</b>	<b>Quasi-brittle cracking, coupled processes and hydraulic fractures</b>	<b>Connecting scales and disciplines to model fracture</b>
Chair	<b>M. Jirásek</b>	<b>I. Kožar</b>	<b>A. Rodríguez-Ferran</b>	<b>A. Sapora</b>	<b>G. Pijaudier-Cabot</b>	<b>C. Greff</b>
16:00	N. Moës*, B. Le: <i>The time-step choice in regularized damage model simulations</i>	X. Liu*, C.H. Lee, P. Grassl: <i>Elasto-plastic-damage model for concrete subjected to high strain rates</i>	B.H.H.A. Cordewener, M.G.D. Geers, J.J.C. Remmers*: <i>A numerical framework to analyze the conductivity of 3D printed tracks under mechanical loading (keynote lecture)</i>	A. Doitrand*, D. Leguillon, G. Molnar, V. Lazarus: <i>New insight into crack front segmentation into facets under mixed mode I+III loading: The role of T-stress and mode-dependent fracture properties (keynote lecture)</i>	C. Konstantinou*, P. Papanastasiou: <i>Fluid flow and fracturing in weakly cemented porous media: An insight into the underlying mechanisms</i>	J. Bobinski: <i>Towards a proper and efficient continuum constitutive laws of plain and reinforced concrete specimens – a short comparative study</i>
16:20	B. Li*, I. Ang, N. Bouklas: <i>Stabilized formulation for phase-field fracture in nearly incompressible hyperelasticity</i>	E. Eid*, A. Gravouil, G. Molnar: <i>Rate-dependency influence on limiting crack-tip speeds in dynamic phase field</i>			I. Carol*, L. Barandiaran, D. Garolera, J. Alvarellós, E. Ibáñez: <i>HF propagation with proppant injection using the FEM with zero-thickness interface elements</i>	I. Marzec*, J. Suchorzewski, J. Bobinski: <i>Experimental and numerical investigation of cracking in steel fibre reinforced high performance concrete members</i>
16:40	H.-Y. Kim, H.-G. Kim*: <i>Adaptive mesh refinement and coarsening for the analysis of three-dimensional phase-field fracture with discrete cracks</i>	B. Le*, N. Moës, A. Stershic: <i>Dynamic rupture and fragmentation of a bar with the phase-field and Lip-field approach</i>	A. Coq*, J. Diani, S. Brach: <i>Experimental characterization and numerical modeling of a DCDC test for a thermoplastic polymer</i>	I.G. García*, M.T. Aranda, A. Quintanas-Corominas, J. Reinoso: <i>Crack impinging a curved weak interface: Competition between deflection and penetration</i>	C. Peruzzo*, B. Fryer, B. Lecampion: <i>Can a bi-lateral stress jump really arrest the height growth of a hydraulic fracture?</i>	M. Sarem*, N. E. Deresse, J. Ulloa, E. Verstryngge, S. Francois: <i>Modeling fracture behavior of Brazilian splitting tests using micromechanics-based variational phase-field method</i>
17:00	I. Jain, A. Muixí, C. Annavarapu, S.S. Mulay*, A. Rodríguez-Ferran: <i>An adaptive phase-field method to model fracture propagation in orthotropic materials</i>	S. Durussel*, G. Anciaux, L. De Lorenzis, J.-F. Molinari: <i>Dynamic fragmentation using phase-field modeling of fracture</i>	R. Gopalsamy*, N. Chevaugéon, O. Chupin, F. Hammoum: <i>Fracture in viscoelasticity: Comparison of a phase-field and a Lip-field approach</i>	A.S. Karthik*, V. Mantic, M. Paggi, M. Munoz Reja, L. Távora: <i>Finite element implementation of the coupled criterion based on the principle of minimum total energy subjected to a stress condition to predict crack onset and growth</i>	J. Wang, G. Xotta*, A. Sonntag, A. Wagner, W. Ehlers: <i>Modelling of natural hydraulic fracturing in sandstone cylinders</i>	K. Cosseron*, F. Meray, D. Soria, J. Jaravel, N. Osipov, V. Chiaruttini: <i>Z-cracks – Industrial validation of a 3D fracture mechanics simulation software (online lecture)</i>
17:20	C.P. Rao, A. Aditya, H. Subramanian*, S.S. Mulay, C. Annavarapu: <i>Extension of phase-field method for predicting fracture path in bi-materials by strong-form meshless method</i>	J. Zghal*, N. Moës: <i>Limitation of the delay damage model in dynamics</i>		M.A. Herrera-Garrido*, V. Mantič: <i>A new computational procedure for singularity analysis of interface cracks with frictional contact in anisotropic bimerials</i>	P.R. Cleto*, L.G. Barbosa, M.A. Maedo, E.A. Rodrigues, O.L. Manzoli: <i>Numerical modeling and simulation of the interaction between hydraulic and natural fractures using high aspect ratio interface elements</i>	

## CFRAC 2023 – Parallel Sessions, Friday, 23 June 2023

- DDF**     **Data, damage and fracture**  
organized by O. Allix, P. Carrara
- EFE**     **Enriched finite element formulations for fracture**  
organized by J. Alfaiate, L.J. Sluys
- FB**      **Fracture benchmark**  
organized by J. Réthoré
- FFM**     **Finite fracture mechanics: Models and applications**  
organized by I. García, D. Leguillon, V. Mantič, A. Sapora
- NRFM**   **Numerical aspects of regularized failure models**  
organized by L. De Lorenzis, M. Jirásek, C. Maurini, N. Moës
- QBC**     **Quasi-brittle cracking, coupled processes and hydraulic fractures**  
organized by I. Carol, G. Pijaudier-Cabot, G. Xotta
- RFM**     **Regularized failure models: Phase-field and other models**  
organized by L. De Lorenzis, M. Jirásek, C. Maurini, N. Moës

Hall	C204	C208	C215	C217	C221	C223
Session	NRFM-II	EFE-I	RFM-VII	FFM-II	QBC-IV	FB-I
Mini-symp.	<b>Numerical aspects of regularized failure models</b>	<b>Enriched finite element formulations for fracture</b>	<b>Regularized failure models: Phase-field and other models</b>	<b>Finite fracture mechanics: Models and applications</b>	<b>Quasi-brittle cracking, coupled processes and hydraulic fractures</b>	<b>Fracture benchmark</b>
Chair	<b>N. Moës</b>	<b>J. Alfaiate</b>	<b>L. De Lorenzis</b>	<b>I. García</b>	<b>G. Xotta</b>	<b>J. Réthoré</b>
11:00	W.N. Munshi*, C. Annavarapu, S. Mulya, A. Rodríguez-Ferran: <i>Numerical modelling of three-dimensional fracture propagation in layered materials using parallel computing</i>	A. Duarte*, N. Shauer: <i>3-d modeling of multi-stage hydraulic fracturing from a borehole within a GFEM framework</i>	B. R. Nogueira*, G. Rastello, C. Giry, F. Gatuingt, C. Callari: <i>Isotropic and anisotropic eikonal gradient-enhanced damage models: Thermodynamics derivation and simulation of quasi-brittle materials</i>	D. Leguillon*, T. Lube, R. Bermejo: <i>Failure of notched zirconia specimens under residual stress</i>	F. Loiseau*, C. Oliver-Leblond, R. Desmorat: <i>Modeling anisotropic damage using a reconstruction by rational covariants of the elasticity tensor obtained by discrete element tests</i>	J. Réthoré: <i>Introduction, presentation of the benchmark</i>
11:20	R. Assaf*, C. Birk, H. Gravenkamp, S. Natarajan: <i>Investigating brittle fracture with an adaptive phase-field model using the scaled boundary finite element method in three dimensions</i>	S. Bhattarai*, L. J. Sluys: <i>Modeling combined necking cracking phenomena using different modeling techniques</i>	B. Masseron*, G. Rastello, N. Moës, R. Desmorat: <i>"Lip-field" regularization of anisotropic damage</i>	J. L. Guzmán, V. Mantič*, L. Távora, M. Muñoz-Reja: <i>FEM implementation of the minimization of the total energy subjected to a stress condition to predict delaminations in ILTS tests</i>	X. Gu*, P.Y. Liu, X.Z. Xia, Q. Zhang: <i>Peridynamics for soil desiccation cracking simulation: Coupled hygro-mechanical model, staggered and monolithic solution</i>	<a href="#">G. Molnar: Simulation results</a>
11:40	G. Rastello*, N. Moës, B. Masseron: <i>Robust solvers for "Lip-field" damage models</i>	M. Rocha*, J. Trevelyan, E.D. Leonel: <i>An eXtended IGABEM formulation for the direct determination of SIFs in three-dimensional cracked bodies</i>	S. Nagaraja*, U. Römer, H. G. Matthies, L. De Lorenzis: <i>Deterministic and stochastic phase-field modelling of anisotropic brittle fracture</i>	S. Jiménez-Alfaro*, D. Leguillon: <i>Modelling of glass matrix composites by the coupled criterion and the matched asymptotic approach: The effect of residual stresses and the volume fraction</i>	H. Liu*, L. Mao, F. Hild: <i>Damage growth in coal under uniaxial compression</i>	<a href="#">A. Doitrand: Simulation results</a>
12:00	K. Jukic*, T. Jarak: <i>Dual-mesh approach to discretisation for phase-field fracture method</i>	A.M. Aragón*, Y. Yan, J. Zhang: <i>A discontinuity-enriched finite element method for crack growth in brittle materials</i>	M. Sakha*, L. De Lorenzis, T. Driesner: <i>Assessment of a phase-field model with orthotropy-based energy decomposition to predict mixed-mode fracture in rocks</i>	A. M. Mirzaei*, P. Cornetti, A. Sapora: <i>A model based on finite fracture mechanics to predict the fatigue lifetime of notched components</i>	F. Suárez: <i>Parameter calibration of a fibre-reinforced concrete fracture model by means of co-simulation between OOFEM and Scipy</i>	<a href="#">A. Jacon: Simulation results</a>
12:20	S. Loehnert*, V. Klempt, C. Krueger, L. Munk: <i>An enriched phase-field approach for the efficient simulation of fracture processes in 2D</i>	K. Li, A. Rodríguez-Ferran, G. Scovazzi*: <i>The shifted fracture method</i>	B. Sobhaniragh*, H. Habibi: <i>Interactions of phase transformation and crack propagation in anisotropic microstructures</i>	A. Chao Correias*, A. Sapora, J. Reinoso, M. Corrado, P. Cornetti: <i>Finite fracture mechanics versus phase field models of fracture: A case study on the crack onset from circular holes under biaxial loadings</i>		<i>Discussion (moderated by J. Réthoré)</i>

Hall	C204	C208	C215	C217	C221	C223
Session		EFE-II	RFM-VIII	FFM-III	DDF-III	FB-II
Mini-symp.		Enriched finite element formulations for fracture	Regularized failure models: Phase-field and other models	Finite fracture mechanics: Models and applications	Data, damage and fracture	Fracture benchmark
Chair		L.J. Sluys	C. Maurini	D. Leguillon	E. Baranger	J. Réthoré
14:00		A.U. Martínez-Miranda*, G. Juárez-Luna: <i>Inelastic analysis of frames using thin beam-column elements with multiple embedded plastic hinges</i>	A. Jaccon*, B. Prabel, G. Molnár, A. Gravouil, J. Bluthé: <i>Fatigue crack propagation with a phase-field approach coupled to adaptive mesh refinement and cycle jump schemes</i>	T. Duminy*, A. Doitrand, S. Meille: <i>Influence of elastic and fracture anisotropy on architected materials using coupled criterion and matched asymptotic approach</i>	M. Manav*, R. Molinaro, S. Mishra, L. De Lorenzis: <i>Phase-field fracture modeling using physics-informed deep learning</i>	<a href="#">B. Lé:</a> <a href="#">Simulation results</a>
14:20		F. Xu*, H. Hajibeygi, L.J. Sluys: <i>Multiscale extended finite element method for simulation of fractured geological formation with propagating fractures</i>	O. Voreux*, S. Feld-Payet, P. Kanouté, S. Kruch: <i>High temperature fatigue crack growth modeling in Ni-based superalloys using a gradient-enhanced elastic-viscoplastic damage model</i>	M. Rettl*, M. Pletz, C. Schuecker: <i>Crack initiation from arbitrary 2d notches: Efficient multi-scale models using the finite fracture mechanics concept</i>	A. Harandi*, S. Rezaei, A. Moeineddin, T. Brepols, S. Reese: <i>Phase-field fracture model solved by a mixed formulation for physics-informed neural networks</i>	<a href="#">J. Triclot:</a> <a href="#">Simulation results</a>
14:40		S. Marfia*, E. Monaldo, E. Sacco: <i>Virtual element method for mixed-mode cohesive fracture simulations</i>	C. Krüger*, V. Klempt, S. Loehnert: <i>An extended phase-field method (XPFM) for the simulation of fatigue fracture processes</i>	F. Ferrian*, A. Chao Correas, P. Cornetti, A. Sapora: <i>Finite fracture mechanics: Size effects on spheroidal voids and corrosion pits</i>	M. Alves Maia*, N. Kovacs, I.B.C.M. Rocha, F. P. van der Meer: <i>Physically recurrent neural networks for homogenization of path-dependent heterogeneous materials</i>	<a href="#">J. Zhang, A. Aragon:</a> <a href="#">Simulation results</a>
15:00		J. Alfaiate*, L.J. Sluys: <i>A new approach to model softening in quasi-brittle materials</i>	A. Rodella*, A. Favata, C. Maurini, S. Vidoli: <i>A phase-field model describing Paris fatigue law</i>		<i>General discussion (moderated by P. Carrara and O. Allix)</i>	<i>Discussion and conclusions (moderated by J. Réthoré)</i>
15:20						

# CFRAC 2023 – Social Activities

## Tuesday, 20 June 2023

16:00-19:00 Welcome drink in the lobby (Faculty of Civil Engineering, Czech Technical University, Thákurova 2077/7, Prague 6)

## Wednesday, 21 June 2023

19:30-22:00 Concert and reception in Bethlehem Chapel (Betlémské náměstí 255/4, Prague 1)  
*To reach Bethlehem Chapel, walk from the conference venue to the Dejvická metro station (approx. 7 minutes), take metro line A (direction Depo Hostivař) to Můstek, and then walk (approx. 7 minutes). The concert starts at 19:30 sharp, so please arrive earlier to get seated. The concert takes about 1 hour and is followed by a buffet-style reception.*

Bohemia Chamber Orchestra with soloists Marie Fajtová (soprano) and Roman Patočka (violin)

Jan Zach:  
(1713-1773) Sinfonia no. II in A Major  
Allegro-Siciliano-Presto

J. S. Bach:  
(1685-1750) Violin Concerto in E Major BWV 1042  
Allegro-Adagio-Allegro assai

Giuseppe Giordani: Caro Mio Ben  
(1751-1798)

W. A. Mozart:  
(1756-1791) Alleluia from Exsultate, jubilate, K. 165

Samuel Barber:  
(1910-1981) Adagio for strings, op. 11

Antonín Dvořák:  
(1841-1904) Excerpt from Rusalka

Niccoló Paganini: Il carnevale di Venezia, op. 10  
(1782-1840)

## Thursday, 22 June 2023

20:00-22:30 Conference dinner in Letenský zámeček (Letenské sady 341, Prague 7)  
*To reach Letenský zámeček, walk from the conference venue to the Thákurova tram stop on Evropská street (approx. 5 minutes). Take tram No. 26 (direction Nádraží Hostivař) to Letenské náměstí (5th stop, 10 minutes), then walk (approx. 8 minutes). The dinner will officially start at 20:00 but welcome drinks are served already from 19:30. Letenský zámeček is located in a park above the river and, if you arrive even earlier, you can enjoy walking around and watching the city from above.*

# CFRAC 2023

**The Seventh International Conference on Computational Modeling of Fracture and Failure of Materials and Structures  
Prague, Czechia, 21-23 June 2023**

This ECCOMAS Thematic Conference is jointly organized by Milan Jirásek, Olivier Allix, Nicolas Moës and Laura De Lorenzis, with the assistance of Conference Partners Prague Ltd.

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