

邢会林教授简历

中国海洋大学海底科学与工程计算国际中心主任
海底科学与探测技术教育部重点实验室/海洋地球学院
澳大利亚昆士兰大学地球与环境科学学院

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个人基本情况

- 性别: 男
- 出生年月: 1965 年 09 月
- 籍贯: 山东博兴
- 民族: 汉
- 健康状况: 优良
- 社会兼职: 中南大学荣誉教授, 北京交大兼职教授
- 主要研究领域: 超级计算地学及其地质与资源工程应用
- 最高学历: 博士
- 专业及研究方向: 材料科学与工程 (计算工程科学)
- 毕业院校: 哈尔滨工业大学
- 毕业时间: 1995 年 3 月
- 中国自然科学基金海外杰青获得者
- 亚太地震仿真合作组织澳方负责人;

教育背景

- ❖ 博士 哈尔滨工业大学 材料科学与工程 (计算工程科学) 1992.03-1995.03
- ❖ 硕士 哈尔滨工业大学 材料工程 1989.09-1992.03
- ❖ 学士 哈尔滨工业大学 材料工程 1985.09-1989.07
- ❖ 博士后日本理化学研究所(RIKEN, 相当于中科院) 计算工程科学 1995.11-1997.11

主要工作经历

- ❖ 2018.10 - 中国海洋大学 教授 (筑峰)
- ❖ 2010.06 - 澳大利亚昆士兰大学地学计算中心 主任研究员
- ❖ 2004.09-2010.05 澳大利亚昆士兰大学地学计算中心 高级研究员
- ❖ 2002.02-2004.08 澳大利亚昆士兰大学地学计算中心 研究员
- ❖ 1997.11-2002.01 日本理化研究所 (RIKEN, 相当于中科院) 研究员
- ❖ 1995.11-1997.11 日本理化研究所 (RIKEN) 博士后

主要研究方向

- ▶ 结合地球数字化发展趋势，将数值模拟、超级计算与固体地球科学、地质及资源工程应用相结合；
- ▶ 多尺度多相/多组分多物理场(THMC 含生化) 非线性耦合计算理论（多尺度：孔隙到全球；M3-Multiscale Multiphase Multiophysical Geocomputing）
- ▶ 超级计算机上构筑针对于固体地球科学及工程的高性能虚拟实验室 - 有限元及 LBM 计算与分析软件平台 PANDAS；
- ▶ 局部典型地区或全球规模地壳动力学行为模拟，如某些典型天然或人工工程导致的地震过程孕育、发生、传播的数值模拟及其相关灾害评估、预测；终极目标：**数值地震预报**
- ▶ 数字岩心及非常规油气储层增渗改造（如水力压裂、酸化驱、生物驱、冲击波驱等）的数值模拟分析及优化；
- ▶ 非常规资源及深部地下工程开发的分析与评估，如干热岩发电、非常规油气开采、原煤微生物产气、深部地下工程及金属钨、铀等成矿成藏机理及“甜点”预测等；
- ▶ 海啸过程数值模拟及预警；
- ▶ 材料成形及部件组装的数值模拟及分析。

主要科研成果

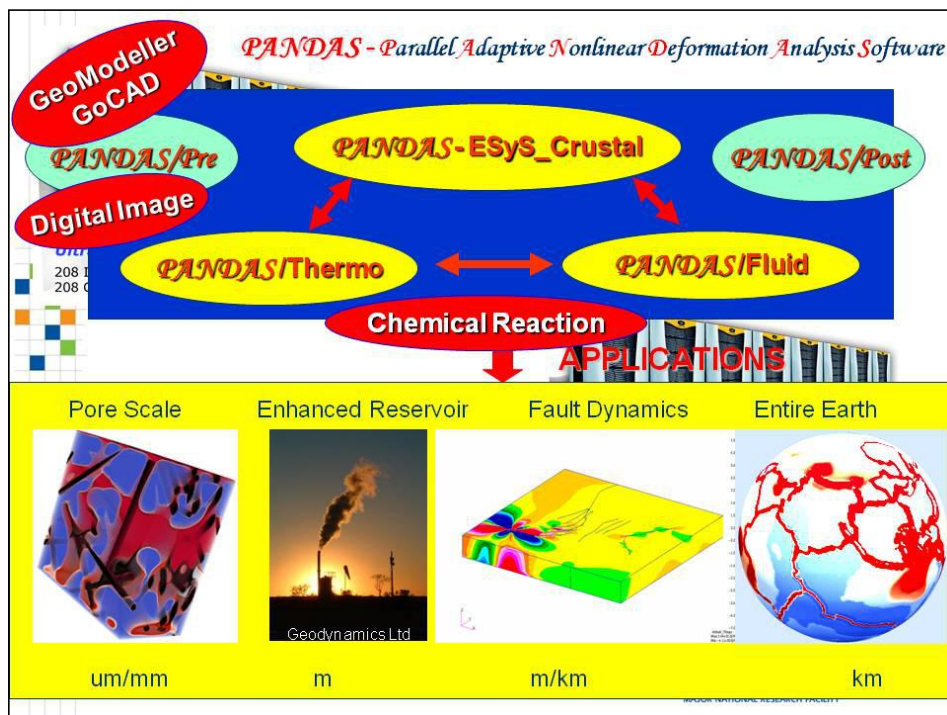
- ▶ 基于有限元及 LBM（Lattice Boltzmann Method）方法，在超级计算机上创建以固体地球科学及相关地质及资源工程为主要研究

对象的多尺度多物理场耦合计算理论及高性能软件平台 PANDAS (见下图)。其中的部分模块是日本国家科技优先发展重大项目“地球模拟器”及澳大利亚计算地球系统科学 (ACcESS) 国家研究设施的基础应用软件, 成为相关软件平台创建升级的基础。所开发的理论模型及软件将数值模拟、计算机技术与地球动力学相结合, 成为昆大地学计算中心, 澳大利亚计算地球国家研究设施 ACcESS (Australian Computational Earth System Simulator, Major National Research Facility), 亚太地震仿真国际合作组织 ACES(APEC Cooperation on Earthquake Simulation) 及 iSERVO(International Solid Earth Research Virtual Observatory) 在高性能计算机上创建以地球动力学及地质工程为主要研究对象的虚拟平台的基础软件, 并通过对相关典型科学与工程问题进行研究得以验证;

- 提出了基于 R-minimum 方案的自适应的动/静相结合有限元方法以稳定高效地模拟多时间尺度的非线性动力学现象, 给出了模拟多孔介质多尺度热-力-流体-地化反应 (含生化) 多场耦合非线性问题的稳定的高性能计算模型, 彻底解决了传统方法模拟非线性问题的收敛性难题, 并应用于地质资源工程及原煤微生物产气过程的模拟与分析;
- 提出了基于 R-minimum 方案的任意形状接触面上的节点到点接触单元, 以模拟多种非均质材料变形体间、变形体与刚性体间的一系列与速率、位移、接触、压力及温度等相关的非线性摩擦接

触问题；已成功应用于典型断层系统（如川滇、苏门答腊、南加州及南澳地区）的地震动力学、非连续非均质材料等非等温大变形过程等的模拟与分析；

- 开展了基于图像大数据的内部特征信息提取及自动自适应网格化处理研究，成功应用于岩石三维 CT/MRI/SEM 等图像的处理（如 10 亿像素点，内含数十条相交叉大裂隙面）、内部复杂裂隙面的自动识别与提取、简化及其空间面三角化，并以此为约束生成可用于有限元计算的三维四面体网格；同时实现了任意断层系统或岩石切片图像的四边形及相应准三维六面体有限元网格的自动生成与计算；



图：所研发的 PANDAS 或 ESys_Crustal 软件及部分应用

- 基于地质材料的非均质多样性，提出了修正的 LBM（Lattice

Boltzmann Method) 以定量计算含多种矿物的多孔或裂隙材料的流体流动及化学反应等动态行为, 并对数字岩心尺寸对上述流动行为进行敏感性分析, 从而得到其 4D 渗透系数; 同时结合 CT/SEM 成像数据及实验, 应用于 CO₂ 注入砂岩岩心和煤样的酸化增渗处理的数值模拟、分析验证及评估;

- ▶ 成功应用于数字岩心的多尺度分析, 非常规油气储层增渗改造 (如水力压裂、酸化驱、生物驱、冲击波驱等) 的模拟分析及优化;
- ▶ 应用于固体地球科学及地质资源工程多尺度描述和多场耦合分析。不仅提供了为定量化研究大规模地球动力学等典型科学及工程问题从而进行相应的灾害评估及管理所必需的科学与技术保障 (断层系统动力学、地震及海啸; 固体地球相关的能源开发及利用: 如干热岩发电的地下库区评估, 非常规油气开发, CO₂ 地质埋藏, 微生物制气, 煤层开采等深部工程; 钨、铀等金属矿成矿机理及评估), 而且也已成为进行相关国内外科研合作的平台;
- ▶ 科研工作获近 20 项国家和国际项目等资助, 总计经费 \$2300 万 (其中 \$320 万为第一负责人); 作为主要成员参与并负责日本地球模拟器 (主要成员)、澳大利亚计算地球科学国家研究设施 (项目五的负责人)、AuScope (ESyS_Crustal 负责人) 和 iSERVO 国际研究院启动项目 (澳方负责人) 等重大项目相关计算模型及软件开发, 取得许多前沿性的研究成果; 7 次国际会议特邀报告和主题报告, 多次国际会议/分会组织者、主席; 发表论文 160 余篇, 包

括编著 2 本 (Springer), SCI 国际期刊论文 70 篇;

- 由于系横跨固体地球科学、岩土及资源工程、力学、计算机科学、软件工程等多学科的交叉领域, 培养了一支既懂地球科学与地质资源工程又懂计算理论、分析及软件研发的创新型复合型人才队伍, 其中博士 15 名 (澳大利亚政府全额奖学金获得者 3 人), 博士后 4 人。同时, 也是中澳合作研究的积极推动者和践行者, 其中至今已接收并资助来自中国 30 所大学和研究单位的访问学者学生 50 人 (6 个月以上)。
- 申请人和他的团队在国际计算地学及应用领域取得了令人瞩目的研究成果, 曾多次被昆士兰大学, 澳洲国家及国际新闻媒体报道 (如 ABC News - 相当于 CCTV 新闻等, SBS news - 相当于 CCTV 国际频道, The Australian - 相当于人民日报, Sky News)。

主要科研项目

澳大利亚工作期间国家及国际外部项目 (16) 如下, 此外获大学内部项目 3 项。

1. 负责澳大利亚地壳动力学计算模拟及相关软件的研究开发工作, 该项目是澳大利亚计算地球系统科学 (ACcESS) 国家研究设施的项目 (项目资金: \$2.0M; ACcESS \$14.8M, 项目时间: 2002-2007; ACcESS - Australian Computational Earth System Simulator, Major National Research Facility) (注: M - 百万, 下同);
2. 作为项目第一申请人负责了澳洲研究委员会 (ARC-Australian Research Council) 和 the Geodynamics Ltd 的 ARC Linkage 合作项目: 用超级计算机对干热岩地热系统进行模拟及评估 (项目资金: 现金\$440,000, 项目时间: 2005-2011)
3. 作为项目唯一申请人负责了 ARC Discovery 项目: 建立海啸发生原理模型 (项

目资金：\$275,000，项目时间：2006-2011）

4. 负责了澳大利亚国家基础设施 AuScope NCRIS 项目中的地壳动力学模拟研究（项目资金：NCRIS 现金\$352,000，项目时间：2007-2011; AuScope NCRIS）
5. 作为项目第一申请人负责了 ARC 国际项目 (ARC Linkage International)：多尺度模拟研究考虑变形的多孔介质模型（项目资金：\$107,000，项目时间：2009-2011）
6. 子项目负责人：印度地质条件下的边墙开采设计和规范，澳大利亚-印度政府国际合作项目（2014-2016）
7. 项目负责人：华北克拉通北缘铀多金属矿化流体动力学数值模拟，中核集团北京核地院国际合作项目，（\$65,000. 2015-2016）
8. 项目负责人之一 ARC Discovery 项目：多相多尺度模拟考虑变形的多孔介质模型（项目资金：\$440,000，项目时间：2011-2015）
9. 项目负责人之一 ARC Discovery 项目：Mudstones as methane sources: gas production from coal seam interburden（项目资金：\$310,000，项目时间：2015-至今）
10. 项目负责人之一工业联合促进项目：提高煤层气产出的压裂增渗技术研究，（\$75000，2012-2014），由昆大，QGC(昆士兰煤层气公司)和中石油联合资助。
11. 参与 ANLEC（Australian National Low Emissions Coal Research & Development- 澳大利亚国家低排放煤炭研究与发展）项目并负责孔隙尺度部分，用 CO₂ 埋藏储层的四维表征方法，风险评估和成本降低的相关方法研究（项目资金：\$600,000，项目时间：2011-2015）
12. 负责中国自然科学基金 2007 年度海外杰青项目（40 万元; 2008-2010）
13. 中国自然科学基金委的重点项目（海外人员）：建立对饱和流体的多孔介质进行机理分析的多级模型和计算方法（项目资金：3.0 百万元，项目时间：2013-2017）
14. 作为海外人员参与了项目石英脉型黑钨矿“五层楼”式垂直行态分带动力学机理研究，该项目为中国自然科学基金委资助项目（项目资金：86 万元，项目时间：2014-2016）
15. 澳方负责人，国际固体地球虚拟研究合作平台项目，负责建立澳大利亚区内

陆板块断层模型和相关模拟软件的研发。

16. 负责人，国际著名岩土工程集团公司 Coffey 咨询项目，活火山口附近露天金矿开发的多相流体流动及其对工程设计的影响(2009-2010)
17. 数值模拟部分负责人：参与 Smart Future 项目并负责模拟部分，废弃煤中生物产气的研究（项目资金：\$1.2M，项目时间：2012-2016）
18. 四个负责人之一， Queensland node of AuScope (\$4.8M, 2007-2011), (AuScope - An Organisation for a National Earth Science Infrastructure Program).

日本理研工作期间（3）：

19. 曾参与日本国家科技优先发展重大项目“地球模拟器”（\$400M，并负责了相关地震动力学软件的研发工作；
20. 参与并负责了日本科技厅项目“核电站基础研究”中的子项目；
21. 曾参与日本 30 多家著名公司共同资助的日本板材成形研究会重大项目：汽车覆盖件的成形仿真系统的研发；

中国哈工大学习工作期间国家项目（4）：

国家自然科学基金（1），原航天部科技项目（1），863 项目（1），国家教委博士基金（1）

主要社会兼职及荣誉

1. 中国国家自然科学基金海外杰出青年基金获得者(项目批准号：40728004)，荣获海外杰出青年称号；
2. 亚太地震仿真国际合作组织澳方负责人
3. 澳大利亚计算地球系统国家研究设施计算地壳动力学负责人
4. 澳洲研究委员会（ARC-Australian Research Council）项目评阅人（DP, LP, DECRE, Fellowship, LEIF 等）
5. 美国物理学协会和中国理论和应用力学协会联合出版的“理论和应用力学快报”的编辑委员会创刊成员（创刊至今）；国际期刊 *Petroleum* 编辑委员会成员
6. 中南大学、重庆大学、成都理工大学荣誉教授；北京交通大学兼职教授。

7. 北京大学, 北京核地院, 中国地震局及日本东京大学等短期访问专家

主要论著清单

论著共 180 余篇, 主要的文章清单如下。其中, *是指导的学生为第一作者, #是指导的年轻博士后或访问学者为第一作者。未有特殊标记的本人第一作者论文, 同时也是通讯作者。

书 **Scholarly Books**

1. Xing, Huilin and Xu, Xiwei. M8.0 Wenchuan Earthquake, 2011, 191 p., Hardcover. Springer-Verlag Berlin Heidelberg. ISBN 978-3-642-01875-6.
2. Xing, Huilin, Advances in Geocomputing. Springer-Verlag Berlin Heidelberg, 2009, 325 p. 124 illus. with DVD., Hardcover, ISBN: 978-3-540-85877-5_
3. Xing, H. L. and Wang, J. H (Ed). Geodynamic Modeling, A Special Issue of Acta Geotechnica, Number 2, 2009. Springer Berlin/Heidelberg(for the selected papers presented in IACGG2007 - International Workshop on Advances in Computational Geomechanics and Geophysics).

书中的章节 **Scholarly Book Chapters:**

4. Xing, H. L., Yu, W and Zhang, J (2009), 3D mesh generation in geocomputing, Chapter II in Advances in Geocomputing, Springer-Verlag GmbH, pp27-64. DOI: 10.1007/978-3-540-85879-9_2.
5. *Liu, Y., Y. Shi, E. O. D. Sevre, H L Xing and D. A Yuen (2009). Probabilistic Forecast of Tsunami Hazards along Chinese Coast, Chapter VIII in Advance in Geo-Computing, Springer-Verlag GmbH, pp279-317, DOI:10.1007/978-3-540-85879-9_8.
6. Xing, H.L.,& Makinouchi, A. (2000), Thermo-elasto-plastic FE modelling of heat exchanger assembling process. In Supercomputing in Nuclear Applications (Yagawa, G., eds), Tokyo, RE032, 1-20

期刊论文 **Referred Journal Articles**

7. *J Yi, H Xing, J Wang, Z Xia, Y Jing (2019). Pore-scale study of the effects of surface roughness on relative permeability of rock fractures using lattice Boltzmann method. Chemical Engineering Science 209, 115178
8. *Y Chen, C Jiang, G Yin, D Zhang, H Xing, A Wei (2019). Permeability evolution under true triaxial stress conditions of Longmaxi shale in the Sichuan Basin, Southwest China. Powder Technology

9. *F Ren, L Ge, V Stelmashuk, TE Rufford, H Xing, V Rudolph (2019). Characterisation and evaluation of shockwave generation in water conditions for coal fracturing. *Journal of Natural Gas Science and Engineering* 66, 255-264
10. *F Ren, L Ge, A Arami-Niya, TE Rufford, H Xing, V Rudolph (2019). Gas storage potential and electrohydraulic discharge (EHD) stimulation of coal seam interburden from the Surat Basin. *International Journal of Coal Geology* 208, 24-36
11. Z Wu, Y Zhang, THW Goebel, Q Huang, CA Williams, H Xing, JB Rundle (2019).
12. Continental Earthquakes: Physics, Simulation, and Data Science—Introduction. *Pure and Applied Geophysics*, 1-8
13. #Xiangchong Liu, Yue Ma, Huilin Xing and Dehui Zhang (2018). Chemical responses to hydraulic fracturing and wolframite precipitation in the vein-type tungsten deposits of southern China. *Ore Geology Reviews*, 102 44-58. doi:10.1016/j.oregeorev.2018.08.027
14. *Jie Yi and Huilin Xing (2018). Finite element lattice Boltzmann method for fluid flow through complex fractured media with permeable matrix. *Advances in Water Resources*, 119 28-40. doi:10.1016/j.advwatres.2018.06.007
15. *Mei-Ben Gao, Tian-Bin Li, Lu-Bo Meng, Chun-Chi Ma and Hui-Lin Xing (2018). Identifying crack initiation stress threshold in brittle rocks using axial strain stiffness characteristics. *Journal of Mountain Science*, 15 6: 1371-1382. doi:10.1007/s11629-018-4847-z
16. #Qi Yao, Xi Wei Xu, Hui Lin Xing, Jia Cheng, Guo Yan Jiang, WeiYu Ma, Jie Liu and Wen Yang (2018). 3D seismogenic model of the 2015 Gorkha earthquake and subsequent seismic risk. *Chinese Journal of Geophysics-Chinese Edition*, 61 6: 2332-2343. doi:10.6038/cjg2018L0371
17. *Fei Ren, Lei Ge, Thomas E Rufford, Huilin Xing and Victor Rudolph (2018). Permeability enhancement of coal by chemical-free fracturing using high-voltage electrohydraulic discharge. *Journal of Natural Gas Science and Engineering*, 57 1-10. doi:10.1016/j.jngse.2018.06.034
18. #Liu, Xiangchong, Ma, Yue, Xing, Huilin and Zhang, Dehui (2018) Chemical responses to hydraulic fracturing and wolframite precipitation in the vein-type tungsten deposits of southern China. *Ore Geology Reviews*, 102 44-58. doi:10.1016/j.oregeorev.2018.08.027
19. *Yi, Jie and Xing, Huilin (2018) Finite element lattice Boltzmann method for fluid flow through complex fractured media with permeable matrix. *Advances in Water Resources*, 119 28-40. doi:10.1016/j.advwatres.2018.06.007
20. *Gao, Mei-Ben, Li, Tian-Bin, Meng, Lu-Bo, Ma, Chun-Chi and Xing, Hui-lin (2018) Identifying crack initiation stress threshold in brittle rocks using axial strain stiffness characteristics. *Journal of Mountain Science*, 15 6: 1371-1382.

doi:10.1007/s11629-018-4847-z

21. Yao, Qi, Xu, XiWei, Xing, HuiLin, Cheng, Jia, Jiang, GuoYan, Ma, WeiYu, Liu, Jie and Yang, Wen (2018) 3D seismogenic model of the 2015 Gorkha earthquake and subsequent seismic risk. *Chinese Journal of Geophysics-Chinese Edition*, 61 6: 2332-2343. doi:10.6038/cjg2018L0371
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