

## KEMAL HANJALIĆ

Dipl. ing. (Mašinski fakultet, Univerzitet u Sarajevu, 1964)

M. Sc. (University of Birmingham, UK, 1966)

Ph. D. (Imperial College, University of London, UK, 1970)



Emeritus profesor Univerziteta u Sarajevu i Tehničkog univerziteta Delft, Nizozemska, radio je kao stručni i naučni saradnik u Institutu za termotehniku i nuklearnu tehniku ITEN-Energoinvest (1964–1980), nastavnik na Mašinskom fakultetu u Sarajevu od 1968. (profesor od 1979), profesor Univerziteta Erlangen-Nürnberg (1991–1993), na tehničkim univerzitetima Michigan, SAD (1993–1994), Delft (1994–2005) i Darmstadt (2005–2007), profesor i titular (EU) Marie Curie katedre na Sapienza univerzitetu u Rimu, Italija (2007–2010) te vodeći naučnik (dobitnik „mega“ granta) Ministarstva za nauku i obrazovanje Ruske Federacije pri Državnom univerzitetu Novosibirsk (2011–2015).

Naučna i stručna djelatnost obuhvata fundamentalna i primijenjena istraživanja u oblasti termo-fluidnih nauka (mehanika fluida, termotehnika – prenos toplote i mase, sagorijevanje, magneto-hidro dinamika). Spada među najcitanije naučnike s naših područja i ima međunarodnu reputaciju jednog od pionira i vodećeg naučnog autoriteta u oblasti matematskog modeliranja turbulencije i transportnih procesa. Održao je više od 60 plenarnih i uvodnih (keynote) predavanja na međunarodnim konferencijama.

Radio je i na razvoju novih uređaja i procesa u termotehnici i termoenergetici, posebno zavojnih kompresora (s N. Stošićem, realizirani u tvornici Trudbenik, Energoinvest), novog metoda gasifikacije uglja, pulzirajućih gorionika te metode detonacionog otklanjanja naslaga u velikim kotlovima (dva patenta s I. Smajevićem, realizirani od 1989. i u pogonu na dva kotla u Termoelektrani Kakanj).

Obavljao je više stručnih i društvenih funkcija: direktor Instituta za procesnu tehniku, energetiku i tehniku sredine (1980–1984), prodekan (1975–1978) i dekan (1984–1985) Mašinskog fakulteta u Sarajevu te gradonačelnik Sarajeva (1985–1987). Bio je takođe član Izvršnog vijeća Bosne i Hercegovine (1987–1991) kada je pokrenuo i vodio izradu prve Strategije naučno-tehnološkog razvoja BiH, usvojene na Skupštini BiH 1989, te projekat modernizacije i obnove istraživačke i pedagoške opreme na svim univerzitetima u BiH. Bio je delegat Jugoslavije u Komitetu za životnu sredinu OECD-a u Parizu, predsjednik Savjeta zajednica za naučni rad Jugoslavije (1987–1988) te predsjednik Zajednice gradova i opština Jugoslavije (1985–1986).

Predavao je i konsultirao na brojnim univerzitetima i institutima u BiH, Ex-Jugoslaviji i inostranstvu (Cambridge, Darmstadt, Erlangen, Geteborg, Imperial College – London, Krakow, Kyoto, Tokyo, Sapienza univerzitet u Rimu, Singapur, Univ. Kalifornije Davis, NASA Langley i dr.).

Glavni je urednik časopisa “Flow, Turbulence and Combustion” (Springer) i član uređivačkih odbora više međunarodnih časopisa. Sada je predsjednik Međunarodnog centra za prenos toplote i mase (ICHMT, Ankara) te član više naučnih i stručnih organizacija.

Dobitnik je više nagrada i priznanja: Max-Planck naučna nagrada, Njemačka (1992), 27-julska nagrada Bosne i Hercegovine (1989), Veselin Masleša (1973), odlikovanja Kraljice Nizozemske (Officer reda Oranje-Nassau, 2010) i Predsjednika Finske (Commander 1st Class reda Lion of Finland, 1986), viši doktorat (DSc) Univerziteta u Londonu (1998), Dr. honoris causa Univerziteta Reims, Champagne i Ardenne, Francuska (2010). Izabran je za inostranog člana (Fellow) Kraljevske akademije za tehniku (FREng, UK, 2005) te Instituta za fiziku, London (FInstP, 2004), Američke asocijacije mašinskih inženjera (FASME, 2005) i ICHMT (F-ICHMT, 2005).

Za dopisnog člana ANUBiH izabran je 1981, a za redovnog 1987. godine.

## Kemal Hanjalić: Bibliografija (Sept. 2014)

Doktorska disertacija: *Two-dimensional asymmetric turbulent flow in ducts*, Imperial College of Science and Technology, University of London, UK, 1970.

Magistarski rad: *Heat transfer in simulated nucleate boiling*, Graduate School of Thermodynamics, University of Birmingham, UK, 1966.

### I. Knjige (Books)

#### I.1. Autor / koautor (Author / Co-author)

1. **Kemal Hanjalić**, Brian E. Launder, 2011, *Modelling Turbulence in Engineering and the Environment*, Cambridge University Press, Cambridge UK, ISBN 978-0-521-846575-5, 380 pages.
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#### I.2. Urednik / kourednik (Editor / Co-editor)

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## II. Poglavlja / prilozi u knjigama (Chapters / articles in books / edited volumes)

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## V. Radovi u zbornicima (Articles in conference proceedings)

### V.1. Plenarna i uvodna predavanja (Keynote and panel lectures)

1. **Hanjalić, K.**, 2014, Hybrid LES/RANS Models Revisited: Some Challenges in Computations of Internal Flows, *Fifth HLRM Symposium*, 19-21 March 2014 Texas A&M University, College Station, USA.
2. **Hanjalić, K.**, 2012, Some Continuing Challenges in Turbulent Convection (invited lecture), *Paradoxes and Unsolved Problems in Heat Transfer*, Symposium dedicated to the 85<sup>th</sup> birthday

of Academician Aleksandr Ivanovich Leontiev, Ruska Akademija Nauka, 23-25 maj 2012, Zvenigorod, Rusija.

3. **Hanjalić, K.**, 2012, Blending RANS and LES for High Reynolds and Rayleigh Wall-Bounded Flows: Potential and Snares (keynote lecture), *XX Fluid Mechanics Conference*, 17-20 sept. 2012, Gliwice, Poljska.
4. **Hanjalić, K.**, 2012, Detonation-wave technique for on-load deposit removal in coal-fired boilers (keynote lecture), *VIII Всероссийской конференции с международным участием Горение Твёрдого Топлива (Combustion of solid fuel)*, 13-16 nov. 2012, Novosibirsk, Rusija.
5. **Hanjalić, K.**, 2011, Blending the RANS and LES concepts for computing industrial and environmental flows: a perspective (keynote lecture), *Proc. XXIII Int. Automotive Conference "Science and Motor Vehicles"*, Belgrade, 19-21. 4. 2011, Proc. + CD Rom, 8 pages.
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7. **Hanjalić, K.**, 2011, Trends and Prospects in RANS Modelling of Turbulent Convection (keynote lecture), *ERCOFTAC (European Research Community for Flow, Turbulence and Combustion), Special Interest Group (SIG) 15 Workshop on Refined Flow Modelling*, Electricité de France R&D Centre, Chatou – Paris, 17-18. 10. 2011, Slide panels.
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9. **Hanjalić, K.**, 2010, Energy Efficiency and Renewable Energy (EERE) in South Eastern Europe (Plenary lecture), *UNESCO-GIZ-REIC Summer School*, Fojnica, 23. 8. – 4. 9. 2010, Slide panels.
10. **Hanjalić, K.**, 2010, Some continuing challenges in computational turbulent convection (Plenary lecture), *ASME 2010 – 3<sup>rd</sup> Joint US-European Fluids Engineering Summer Meeting*, Aug 1-5, 2010, Montreal, Canada, CD ROM Proc.
11. **Hanjalić, K.**, 2008, Modelling of buoyancy driven turbulent flows (Keynote lecture), *CFD Workshop on Test Cases, Databases & Best Practice Guidance for Nuclear Power Plants Applications, KNOO (Keeping the Nuclear Options Open, RC UK Energy Programme)*, July 16, 2008, University of Manchester, UK, CD ROM.
12. **Hanjalić, K.**, 2008, Challenges in modelling large-scale fluid flows in industrial and environmental applications (Plenary lecture), *Int. Conf. Computational and Informational Technologies in Science, Engineering and Education*, 10-14. Sept. 2008, Almaty, Kazakstan, CD ROM.
13. **Hanjalić, K.**, 2008, Turbulence modelling for heat and fluid flow: A view of trends and perspectives, (Keynote lecture), Track 10: Heat Transfer, Fluid Flows, and Thermal Systems. *IMECE 2008 – ASME Int. Mechanical Engineers Congress and Exhibition*, Oct. 31. – Nov. 6, Boston, Ma, USA, CD ROM.
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15. **Hanjalić, K.**, 2007, Will RANS survive LES? A view of perspectives, revisited, (Keynote lecture), *Annual Texas A&M Turbulence Symp.2007*, 26-28. 2. 2007, USA, CD ROM.
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17. **Hanjalić, K.**, 2007, CFD at the RANS/LES crossroad (Keynote lecture), *15<sup>th</sup> Annual Conf. of CFD Society of Canada*, May 27-31, 2007, Toronto, Canada, CD ROM.
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## VI. Publikacije iz opšte tematike (Publications on general topics)

1. **Hanjalić, K.**, 2010, Aspekti naučno-istraživačkog rada, *Stanje i perspektive razvoja naučnoistraživačke i istraživačkorazvojne djelatnosti u Federaciji Bosne i Hercegovine*, ANUBiH, Posebna izdanja, Knjiga CXXX, Centar za sistemska istraživanja, Knjiga 2: 43-63.
2. **Hanjalić, K.**, 2008, Towards research and education excellence: values and evaluations, *Kongres BH naučnika iz zemlje i inostranstva*, 28-31 august 2008, Sarajevo, Internet publication, 18 pages.

3. **Hanjalić, K.**, 2008, Naučno-tehnološka istraživanja u oblasti termoenergetike kod nas: ranija iskustva, potencijal i perspektive, Simpozij: *Aktuelni tehnološki problemi u energetici BiH: mogućnosti i prilika za sopstveni naučno-istraživački doprinos*, 23 oktobar 2008, Sarajevo.
4. **Hanjalić, K.**, 2008, From 'Applied Scientific Research' to 'Flow, Turbulence and Combustion': 60<sup>th</sup> Anniversary of a lastign legacy, *Flow, Turbulence and Combustion*, **80**(4): 413-417.
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6. **Hanjalić, K.**, 2006, Towards research and education excellence: Some experience from a European university of technology, *15<sup>th</sup> Science Conf. on High Education*, Ankara, 7-10 Novembar, 2006, Islamic World Academy of Sciences, 18 pages.
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8. **Hanjalić, K.**, Jones, W.P, Rodi, W., 2000, Professor Brian E. Launder on his 60<sup>th</sup> birthday, *Int. J. Heat and Fluid Flow*, **21**(1): V-VI.
9. **Hanjalić, K.**, 1995, *Heat and Fluid Flow: Reality and Imitations*, Inaugural Lecture, Delft University of Technology, ISBN 90-9019710-9, 28 pages.
10. **Hanjalić, K.**, 1988, Nauka i obrazovanje u funkciji tehnološkog razvoja u svijetu i kod nas, *Opredjeljenja*, **1**, DES Sarajevo, YU ISSN 0351-126X: 26-53.

## VII. Stručni radovi i projekti (Professional works and projects)

Veći broj elaborata i izvještaja o naučno-istraživačkim i razvojim projektima (autor-koautor-urednik), finansiranih od strane nacionanih fondacija za naučni rad i industrije: BiH (SIZ za nauku), Italija, Nizozemska (FOM, STW), Njemačka (DFG, DAAD), SAD (EPA), te projekti u okviru EU programa TEMPUS, INTAS, BRITE EURAM, JOULE, GROWTH, FP5, od kojih se navode najznačajniji:

1. **Hanjalić, K.** (koordinator/urednik), 1986-91, Razvoj i proizvodnja energetske, procesne i druge mašinske opreme visoke efikasnosti na bazi malootpadnih tehnologija sa novim vidovima konverzije energije, Društveni cilj VIII A, Mašinski fakultet u Sarajevu, (SIZ za nauku BiH uz učešće svih značajnijih preduzeća u BiH u oblasti projektovanja, proizvodnje i izgradnje energetskih i procesnih postrojenja i opreme – instituti i fabrike Energoinvesta, Unioninvest, UNIS, Famos, Elektroprivreda BiH i drugi).
2. **Hanjalić, K.** (koordinator/urednik), 1998-2002, Models for Vehicle Aerodynamics "MOVA", EU BRITE-EURAM III project; participants: Delft University of Technology (NI), University of Manchester Institute of Technology (UMIST), UK, Institute for Fluid Mechancs, LSTM – University of Erlangen (Germany), AVL-List GmbH, Graz Austria, Electricitée de France (EDF) Chatou – Paris, PSA Peugeot Citroeeen (DRIA/ SARA/PVMO/AERO), Paris, France.
3. **Hanjalic, K.** (koordinator/urednik segmenta projekta), 2002-2005, Minimisation of NOx Emissions, "MinNOx", EU Programme "Energy, Environment and Sustainable Development"- Key Action 6: "Economic and Efficient Energy for a Competitive Europe"; participants: AVL-List GmbH (Austria), Delft University of Technology (NI), University of Stuttgart (Germany), Chalmers University (Sweden), Kings College, London (UK), DaimlerChrysler AG (Germany), Ford Werke (Germany), AB Volvo (Sweden).
4. **Hanjalic, K.** (koordinator/rednik segmenta projekta), 2003-2005, Magnetic field dynamos – "MAGDYN", EU DG 12, participants: Institute of Physics of the University of Latvia, Delft

University of Technology (NI), Forschungszentrum Rosendorff and Technische Universität Dresden (Germany), CNRS Grenoble (LEGI, CNRS+INPG + University J. Fourier (France),

5. **Hanjalic, K.** (koordinator segmenta projekta), 1996-1999, Study and modelling of near-wall turbulence in IC Engines, EU JOULE III Programme, participants: TU Delft (NI), LSTM University of Erlangen (Germany), Laboratoire de Mécanique des Fluides et d'Acoustique - LMFA, Ecole Centrale de Lyon, Renault S.A. (France),
6. **Hanjalic, K.** (koordinator segmenta projekta), 1992-1995, Thematic network on implementation of refined transition prediction methods for turbomachinery - "Trans-Perturb", participants: Cambridge University (UK), Delft University of Technology, LSTM – University of Erlangen (Germany), University of Thessalonike (Greece).

## VIII. Patenti, Kompjuterski programi (Patents, Computer software)

1. Smajević, I., **Hanjalić, K.**, 1988, patent P1728/88, *Uređaj za pouzdano pogonsko čišćenje ogrijevni površina termoenergetskih i drugih kotlova velike snage pomoću detonacionih talasa*, Jugoslovenski patentni zavod, Beograd, 1988. Method razvijen i testiran u laboratoriju Mašinskog fakulteta u Sarajevu 1983-1986, instaliran i u pogonu (sa manjim prekidima) na dva kotla snage po 300 MWth u TE Kakanj od 1987 godine do danas. Višestruko citiran u *US Patents*. Interes za ovu tehnologiju pokazali ALSTOM (Njemačka), Pratt & Whitney i Diamond Power (USA), Ansaldo (Italija), Elektroprivreda Tesalije i Makedonije u Grčkoj i drugi.
2. Smajević, I., **Hanjalić, K.**, 1988, patent P1756/88, *Uređaj za odnošenje naslaga detonacionim talasima sa unutrašnjih površina reaktora za visokopritisnu gasifikaciju uglja*, Jugoslovenski patentni zavod, Beograd, 1988 (dopuna i adaptacija gore navedenog postupka za primjenu u reaktorima za gasifikaciju uglja).
3. Stošić, N., **Hanjalić, K.**, 1988, "SCORPATH" program za kompjutersku simulaciju procesa u vijčanim kompresorima: User Manual. Mašinski fakultet u Sarajevu. Software razvijen prvobitno za Tvornicu kompresora Energoinvest – Trudbenik, Doboj. Preradjen i proširen 1993 na Univerzitetu u Erlangenu (Njemačka), komerijaliziran u firmi M.A.N., Oberhausen, Njemačka. Nakon dodanih dopuna i proširenja, koristi se i danas u Centru za razvoj kompresora City Univerziteta u Londonu, te u nekoliko proizvođača kompresora u svijetu.
4. Ničeno, B., **Hanjalić, K.**, 2002, "T-Rex" program za LES (Large-Eddy Simulation) (numeričku dinamiku fluida, Computational Fluid Dynamics, CFD), User Manual (vidi takodje II.2); istraživački otvoreni software, baziran na metodi konačnih volumena za nestruktuiranu numeričku mrežu.
5. Hadžiabdić, M., Ničeno, B., **Hanjalić, K.**, 2005, 2007, "T-FlowS" program za numeričku dinamiku fluida: User Manual, Dept of Applied Mechanics and Aerospace, Sapienza University of Rome (Italija). Baziran na "T-Rex" programu, proširen, sa ugradjenim naprednim modelima za RANS (Reynolds-average Navier-Stokes) i LES (large-eddy) simulacije, koristi se za istraživačke potrebe na više univerziteta (Delft University of Technology (NI), Federal Institute of Technology (ETH), Zürich (CH), Imperial College, London, (UK), Sapienza University of Rome (It), University of Gävle / Linköping Institute of Technology, Linköping (Se), Beihang Univeristy, Beijing (China) i dr.

## IX. Mentor doktorskih disertacija (Supervision of PhDs)

1. Stefano Minnoti: *Innovative turbulence models for the simulation of air turbines in wave-energy conversion systems*, 28. 3. 2011, Sapienza University of Rome, Italy.
2. Giovanni Delibra: *URANS, LES and hybrid RANS/LES of flow and heat transfer in thermal turbomachinery*, 1. 2. 2011, Sapienza University of Rome, Italy.
3. Jos Verdoold: *Long-term unsteadiness and large-scale structures in Rayleigh-Bénard convection with and without electro-magnetic forcing*, 26. 10. 2010, TU Delft, NI.
4. Paolo Venturini: *Modelling of wall-deposit formation in two phase gas-solid flows*; Dec 2009, Sapienza University of Rome, Italy
5. Werner Hübner\*\*: *Structures in turbulent, non-premixed swirling natural gas flames*, 2010, TU Delft, NI.
6. Björn Kniesner\*: *Ein hybrides LES/RANS-Verfahren für konjugierte Impuls-, Wärme- und Stoffübertragung mit Relevanz zu Brennkammer-konfigurationen*, 20.1.2008, TU Darmstadt, Germany.
7. Maarten van Reeuwijk: *Direct simulation and regularization modelling of turbulent thermal convection*, 12.03.2007, TU Delft, NI.
8. Mirza Popovac, *Modelling and simulation of turbulence and heat transfer in wall-bounded flows*, 16.10.2006, TU Delft, NI.
9. Muhamed Hadžiabdić: *LES, RANS and combined simulation of impinging flows and heat transfer*, 09.01.2006, TU Delft, NI.
10. Leon Geers: *Multiple-impinging jet arrays: an experimental study on flow and heat transfer*, 09.02.2004, TU Delft, NI.
11. Lukas Thielen: *Modelling and calculation of flow and heat transfer in multiple-impinging jets*; 09.12.2003, TU Delft, NI.
12. Gunarjo S. Budi: *Contribution to advanced modelling of turbulent natural and mixed convection*, 10.10.2003, TU Delft, NI.
13. Krzysztof M. Stawiarski: *Multiple-scale closures for non-equilibrium turbulent flows*, 03.03.2003, TU Delft, NI.
14. Nicolas P. Waterson: *Simulation of turbulent flow, heat and mass transfer using residual-distribution approach*, 13.01. 2003, TU Delft, NI.
15. Bojan Ničeno: *An unstructured parallel algorithm for large-eddy and conjugate heat transfer simulations*, 19.11.2001, TU Delft, NI.
16. Aris Twerda: *Advanced computational methods for complex flow simulation*: 11.12.2000, TU Delft, NI.
17. Robbert L. Verweij: *Parallel computing for furnace simulations using domain decomposition*, 01.10.1999, TU Delft, NI.
18. Ibrahim Hadžić\*\*\*: *Second-moment closure modelling of transitional and unsteady turbulent flows*; 08.02.1999, TU Delft, NI.
19. Saša Kenjereš: *Numerical modelling of complex buoyancy-driven flows*; 02.02.1999, TU Delft, NI.
20. Henry Dol: *Turbulence models for natural convection in side-heated enclosures*, 15.12.1998, TU Delft, NI.

21. Erwin R. Meinders: *Experimental study of heat transfer in turbulent flows over wall-mounted cubes*, 02.11.1998, TU Delft, NL.
22. Pieter A. Nooren: *Stochastic modelling of turbulent natural-gas flames*, 14.09.1998, TU Delft, NL.
23. Suad Jakirlić: *Reynolds-Spannungs-Modellierung komplexer turbulenter Strömungen*, 26.03.1997, Univ. of Erlangen, Germany.
24. Rajfa Musemić: *Prilog razvoju matematskog modela penetrativne turbulentne dvojne difuzije u nestacionarnom stratificiranom fluidu*, 25.11.1996, Univ. Ljubljana, SI.
25. Izet Smajević: *Istraživanje pulzirajućeg sagorijevanja gasovitog goriva sa analizom mogućnosti primjene*, 1991, Univ. Sarajevo, BiH.
26. Slavko Vasić: *Matematsko modeliranje prirodne termalne konvekcije u zatvorenim prostorima*, 1991, Univ. Sarajevo, BiH.
27. Miroslav Sijerčić: *Matematski model simultanog sagorijevanja i gasifikacije spraćenog uglja*, 1991, Univ. Sarajevo, BiH.
28. Leopold Škerget\*: *Robni elementi za nelinearne potencialne probleme in tok viskoznega fluida*; 1984; Univ. Maribor, Slovenia.
29. Nikola Stošić: *Numeričko modeliranje unutarnjih nestacionarnih tokova stišnjivog fluida*, 25.06.1982, Univ. Sarajevo, BiH.
30. Marjan Hudina: *Prenos toplote in padec tlaka na hrapavih površinah*, 1980, Univ. Maribor, Slovenia.

Nedovršene disertacije:

31. Tieying Ding: *Laser diagnostics in turbulent flames*, 1998-2002, TU Delft, NL., *odustala zbog porodičnih razloga (unfinished)*!
32. Emiel van der Plas: *Hybrid simulations of natural convection*; 2000-2004 TU Delft, NL., *odustao zbog bolesti (unfinished)*.

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\* Ko-mentor

\*\* Neodbranjena disertacija, kandidat preminuo 3. maja 2010. nakon predaje koncepta disertacije.

\*\*\* Preminuo 27. septembra 2010.