Etică și Integritate Academică în Cercetarea Științifică și Diseminarea Rezultatelor

IOSUD-UPT, Școala Doctorală de Studii Inginerești
programul de pregătire universitară avansată a doctoranzilor în anul universitar 2020-2021

De la proiectul de cercetare la lucrări științifice:
Dezvoltarea ideilor și distilarea rezultatelor

Prof.dr.ing. Romeo Resiga, Universitatea Politehnica Timișoara

16 martie 2021

Motto

- The more efficient you are at doing the wrong thing, the wronger you become.
- It is much better to do the right thing wronger than the wrong thing righter.
- If you do the right thing wrong and correct it, you get better.

Russell L. Ackoff (1919-2009)

Motto (2)

- there is a difference between efficiency and effectiveness:
  - ✓ it is the difference between "doing things right" and doing "the right thing".

Russel L. Ackoff (1919-2009)

Cercetare-Dezvoltare-Inovare

1. Crearea de cunoastere: obtinerea unor rezultate stiintifice si tehnologice de varf, in scopul trasferarii lor în practica socio-economică
2. Creșterea competitivității economiei: inovare cu impact la nivelul agentilor economici
3. Creșterea calității sociale: găsirea de soluții tehnice care sustin dezvoltarea socială și îmbunătățesc condiția umană.

Atributele Activității de Cercetare-Dezvoltare

Frascati Manual 2015

Guidelines for Collecting and Reporting Data on Research and Experimental Development

https://www.oecd.org/publications/frascati-manual-2015-9789264239012-en.htm

2.5 Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge.

2.7 The activity must be:

- novel – to be aimed at new findings
- creative – to be based on original, not obvious, concepts and hypotheses
- uncertain – to be uncertain about the final outcome
- systematic – to be planned and budgeted
- transferable and/or reproducible – to lead to results that could be possible reproduced

Heilmeier's Catechism

by George H. Heilmeier, Defense Advanced Research Projects Agency
(cathechism = an established group of questions and answers)

George H. Heilmeier, a former DARPA director (1975-1977), crafted a set of questions known as the "Heilmeier Catechism" to help Agency officials think through and evaluate proposed research programs

https://www.darpa.mil/work-with-us/heilmeier-catechism

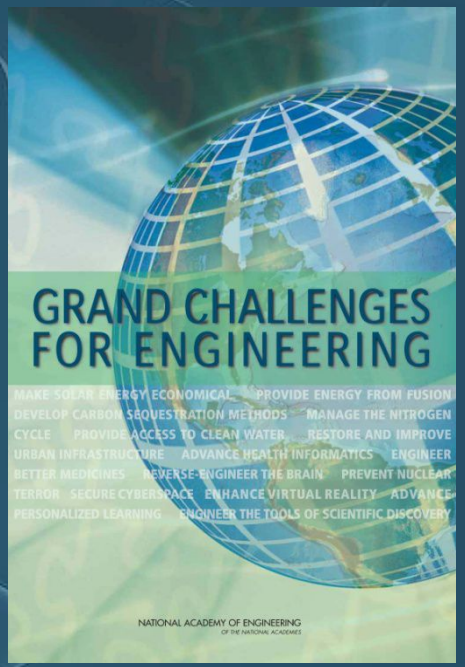
- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today, and what are the limits of current practice?
- What is new in your approach and why do you think it will be successful?
- Who cares? If you are successful, what difference will it make?
- What are the risks?
- How much will it cost?
- How long will it take?
- What are the mid-term and final "exams" to check for success?

Ce cercetăm – dezvoltăm – inovăm ?

Abordați și solutionați provocările curente (e.g. inginerie U.S.A.)

http://www.engineeringchallenges.org/challenges.aspx

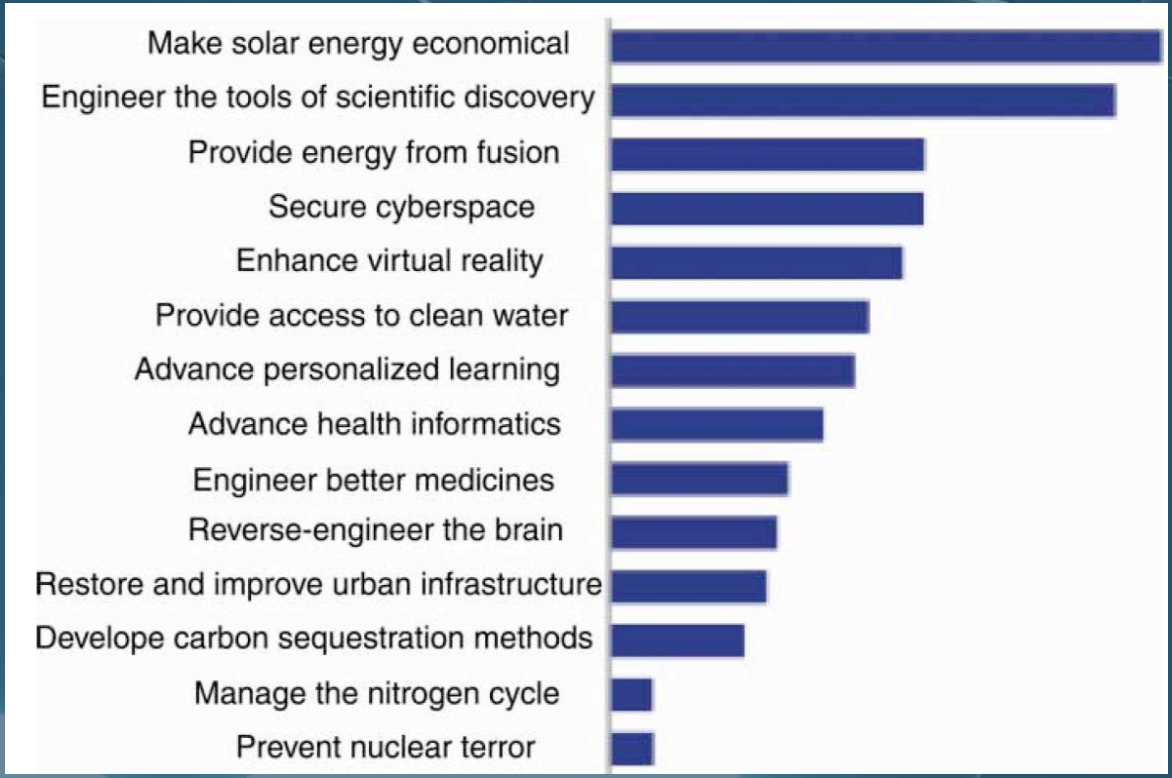
1. Eficientizarea energiei solare
2. Producerea de energie prin fuziune nucleară
3. Dezvoltarea de metode pentru captarea bioxidului de carbon
4. Managementului ciclului azotului în natură
5. Soluţionarea accesului la apă potabilă
6. Reabilitarea şi îmbunătăţirea infrastructurii urbane
7. Dezvoltarea informaticii medicale
8. Personalizarea producerii şi administrării medicamentelor
9. Înţelegerea şi reproducerea funcţionarii creierului
10. Prevenirea ameninţării nucleare
11. Securizarea cyber-spaţiului
12. Îmbunătăţirea şi extinderea tehnicilor de realitate virtuală
13. Educaţie avansată personalizată
14. Dezvoltarea de noi instrumente pentru investigaţii/descoperiri ştiintifice



Ce cercetăm – dezvoltăm – inovăm ?

Care provocari sunt mai atractive? (e.g. inginerie U.S.A.)

Interesul studentilor in inginerie pentru provocarile pe care vor trebui sa le solutioneze



HORIZON EUROPE

STRATEGIC PLAN 2021 – 2024

Missions:

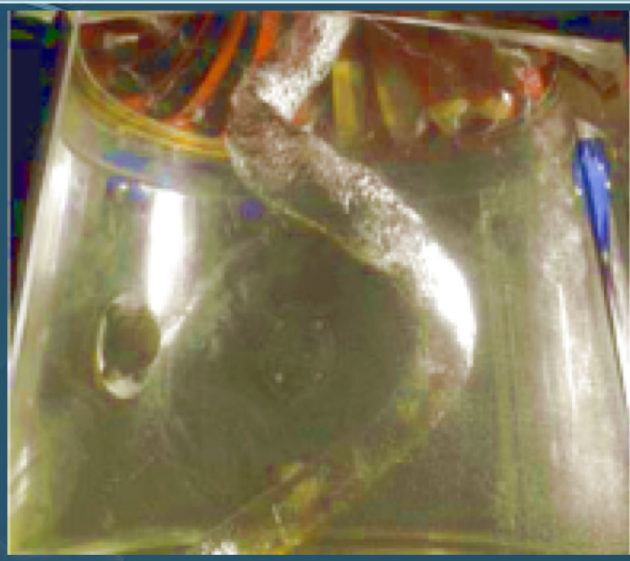
- Cancer
- Adaptation to Climate Change
- Ocean, Seas and Waters
- Climate Neutral and Smart Cities
- Soil, Health and Food

1) Definirea problemei

- Ce doriti sa faceți? Explicati obiectivele fara a folosi (pe cât posibil) termeni de strictă specialitate
- Care sunt soluțiile actuale la problema pe care o abordați, și care sunt limitările acestora?

Ce doriti sa faceti? Explicati obiectivele fara a folosi termeni de stricta specialitate

- Turbinele hidraulice cu palete rotorice nereglabile (turbine Francis, turbine elice) exploatate la debit parțial, prezintă o instabilitate a curgerii în conul aval de rotor, însotita de pulsatii severe de presiune ➔ fluctuații de putere, vibratii puternice, ruperea paletelor rotorice.



  - Dorim să dezvoltam o solutie tehnica de eliminare a CAUZEI instabilitatii curgerii (si implicit atenuarea/ eliminarea efectelor conexe)
  - Solutia propusă NU va modifica traseul hidraulic prin introducerea de obstacole solide (paletaje, aripioare, etc.) și va fi continuu ajustabilă pentru adaptarea optimă la diferite regimuri de funcționare.

Care sunt solutiile actuale si care sunt limitarile acestora ?

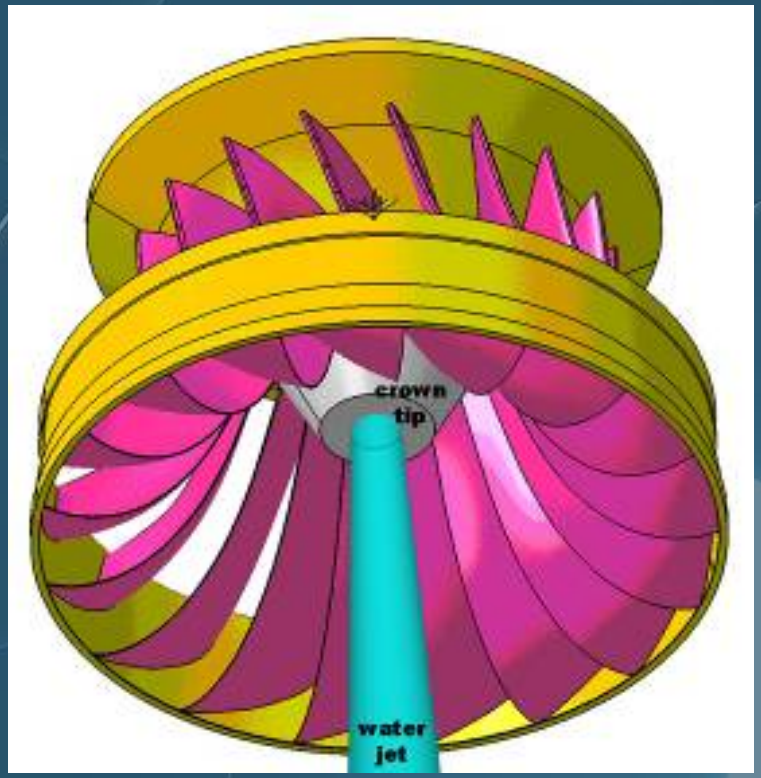
Solutiile actuale se adreseaza atenuarii efectelor instabilitatii curgerii

- Atenuarea pulsatiilor de presiune prin admisie de aer → cresterea elasticitatii fluidului; Se modifica frecventa proprie a sistemului, cu pericolul aparitiei rezonantei in traseul hidraulic
- Montarea de aripioare interioare pe peretele conului → reducerea intensitatii miscarii de rotatie; Se introduc pierderi hidraulice suplimentare, apare cavitatia, au efecte benefice doar pe o plaja restransa de regimuri de operare.

2) Alegerea solutiei

- Care este noutatea in abordarea propusa, de ce credeti ca va avea succes?
- Daca abordarea propusa va avea succes, cui si cum va fi de folos?
- Care sunt riscurile dar si potentialele beneficii ale abordarii pe care o propuneti?

Care este noutatea in abordarea propusa, de ce credeti ca va avea succes?



- Injectam un jet de apa, de-a lungul axei, cu o duza dispusa in butucul rotorului, cu scopul de a elimina CAUZA instabilitatii curgerii cu rotatie in difuzorul conic.
- Solutia NU modifica traseul hidraulic, si permite adaptarea continua a debitului jetului functie de regimul de functionare al turbinei
- Cand nu apar instabilitati, jetul poate fi oprit
- Solutia poate fi implementata la turbinele existente, in cadrul procesului de retehnologizare

Daca abordarea propusa va avea succes, cui si cum va fi de folos?

- Solutia propusa permite exploatarea turbinelor hidraulice (cu rotor ne-reglabil) pe o plaja larga de regimuri de functionare, raspunzand cerintelor variabile ale pietei de energie
- Creste semnificativ productia de energie electrica a hidrocentralei pentru ca nu se mai opreste turbina cand regimul de operare se indeparteaza de optim.

Care sunt riscurile dar si potentialele beneficii ale abordarii pe care o propuneti?

- Alimentarea jetului de control al curgerii poate necesita un debit prea mare pentru a fi rentabil economic
- Solutia tehnica de alimentare a jetului poate necesita modificari constructive in centrala dificil de executat (conducte de alimentare jet)
- Odata implementata, solutia este robusta si nu necesita mentenanta speciala sau sisteme mecanice/hidraulice/electrice complexe de reglaj

TAVORO – TAming the VOrtex ROpe

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International Bureau

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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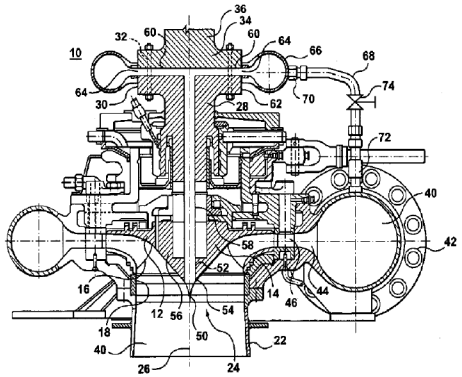
Published:
— *with international search report*

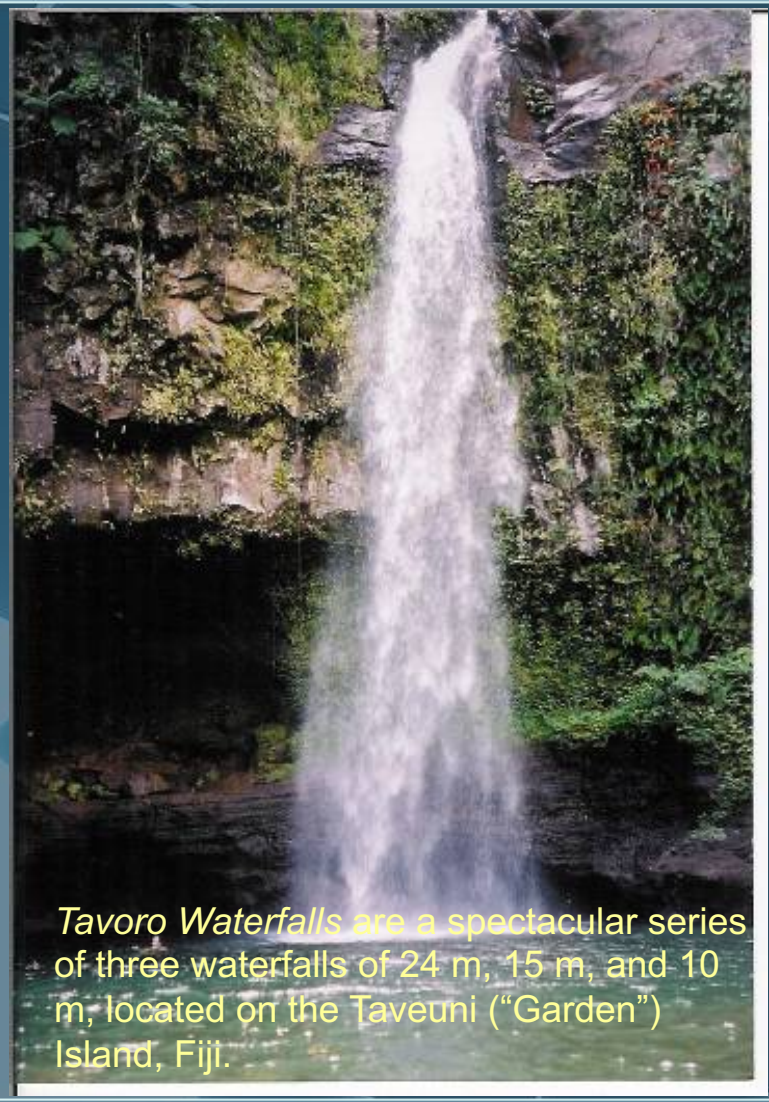
[Continued on next page]

(54) **Title:** LIQUID CONTROL JET DURING PART LOAD OPERATION IN A HYDRAULIC TURBINE



(57) **Abstract:** A method and system to mitigate the pressure fluctuations in hydraulic turbines, operated at partial load, by injecting high velocity control jet (50) or jets of liquid downstream of the turbine runner, on the upper portion of the draft tube (22), along the machine axis; the liquid jet(s) flow rate can be adjusted continuously depending on the pressure fluctuation level in the draft tube, so as to control the swirling flow downstream of the runner and avoid helical vortex breakdown at partial load regimes, thus eliminating the main cause of pressure fluctuations.

WO 2007/142709 A1



Tavoro Waterfalls are a spectacular series of three waterfalls of 24 m, 15 m, and 10 m, located on the Taveuni (“Garden”) Island, Fiji.

Synergy of experiments and theory

Universitatea Politehnica Timişoara

➢SYNERGY: the combined power of a group of things when they are working together that is GREATER that the total power achieved by each working separately

Experimentalists *observe* a lot of things and facts that cannot be explained …

Theoreticians *explain* a lot of things and facts that no one can observe…

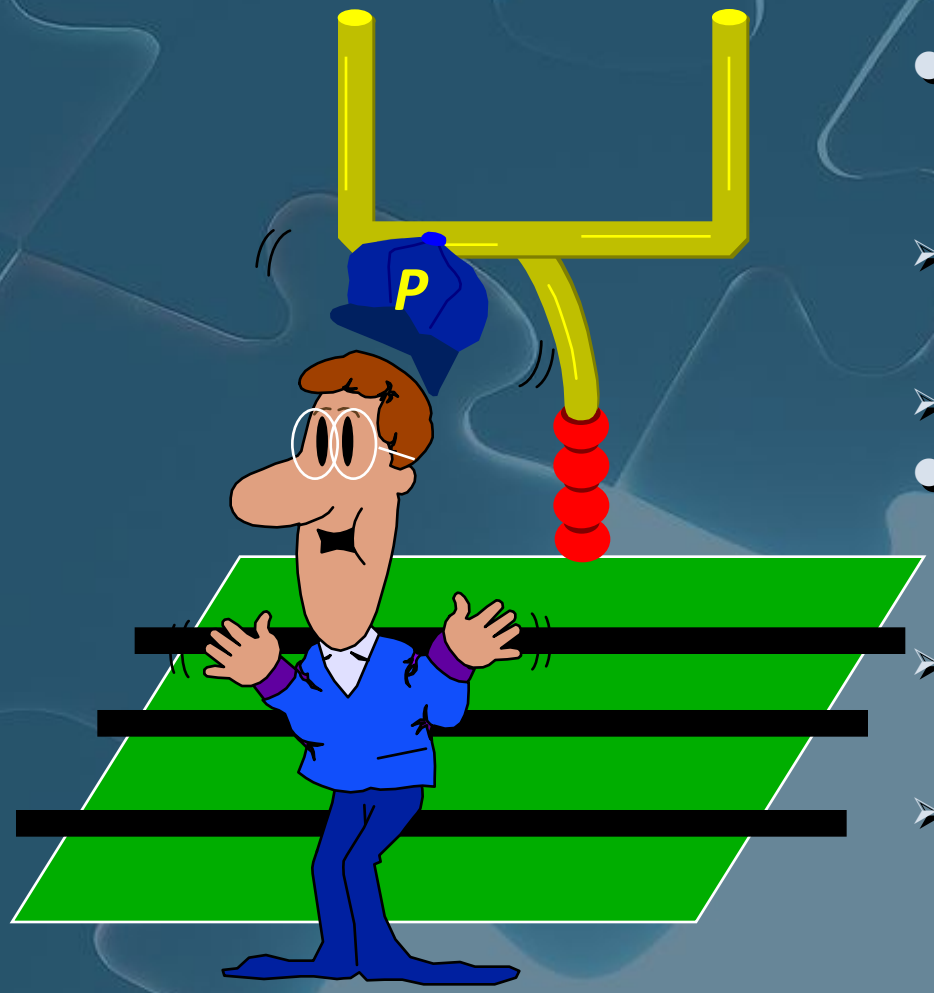
"All truths are easy to understand once they are discovered; the point is to discover them"

—Galileo Galilei, the father of modern science

"Just as houses are made of stones, so is science made of facts; but a pile of stones is not a house and a collection of facts is not necessarily science."

—Jules Henri Poincaré

3) Derularea proiectului

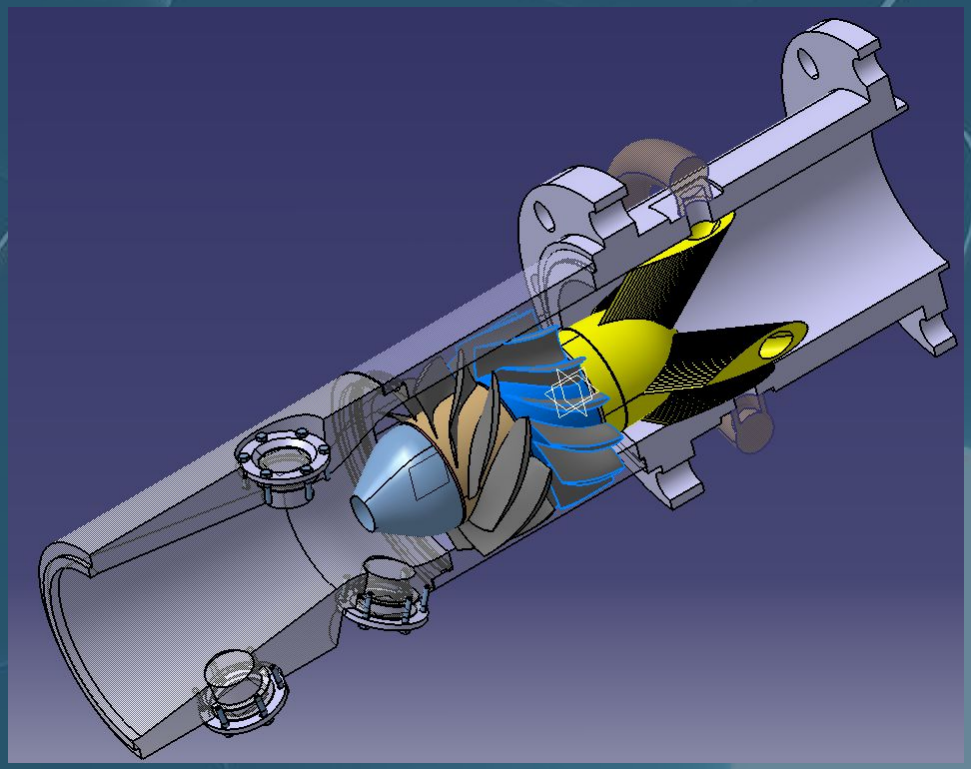


- Stabiliti obiective clare, cu finalitate si durata bine definita.
  - Livrabile: ce ne propunem sa obtinem in urma indeplinirii obiectivului? (verificabil si evaluabil)
  - Obiective anuale / semestriale.
- Indeplinirea obiectivului presupune desfasurarea unor activitati
  - Definiti pentru fiecare activitate "ce se da si ce se cere" Obiective anuale / semestriale.
  - Activitati lunare / saptaminale

Obiectiv: realizare stand experimental

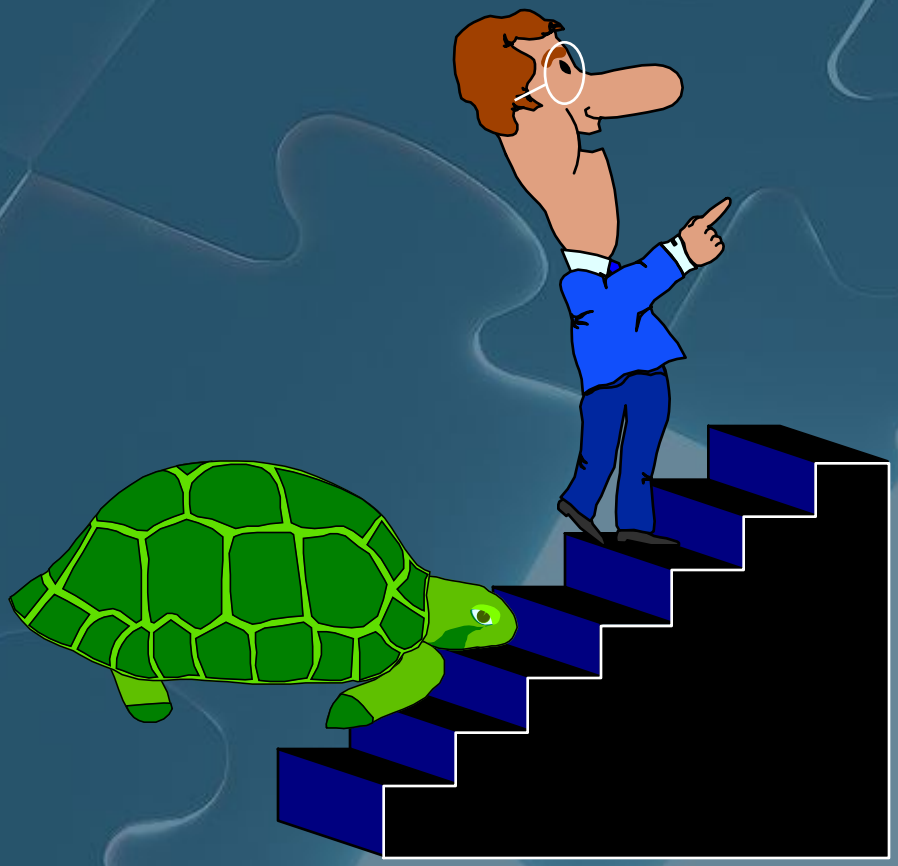
- Realizare circuit hidraulic inchis, cf. specificatii
- Durata: 1 an
- Activitati:
  - Proiectare
  - Achizitie componente
  - Executie componente
  - Montaj
  - Stabilire performante

Obiectiv: realizare sectiune de test și campanii de măsurători



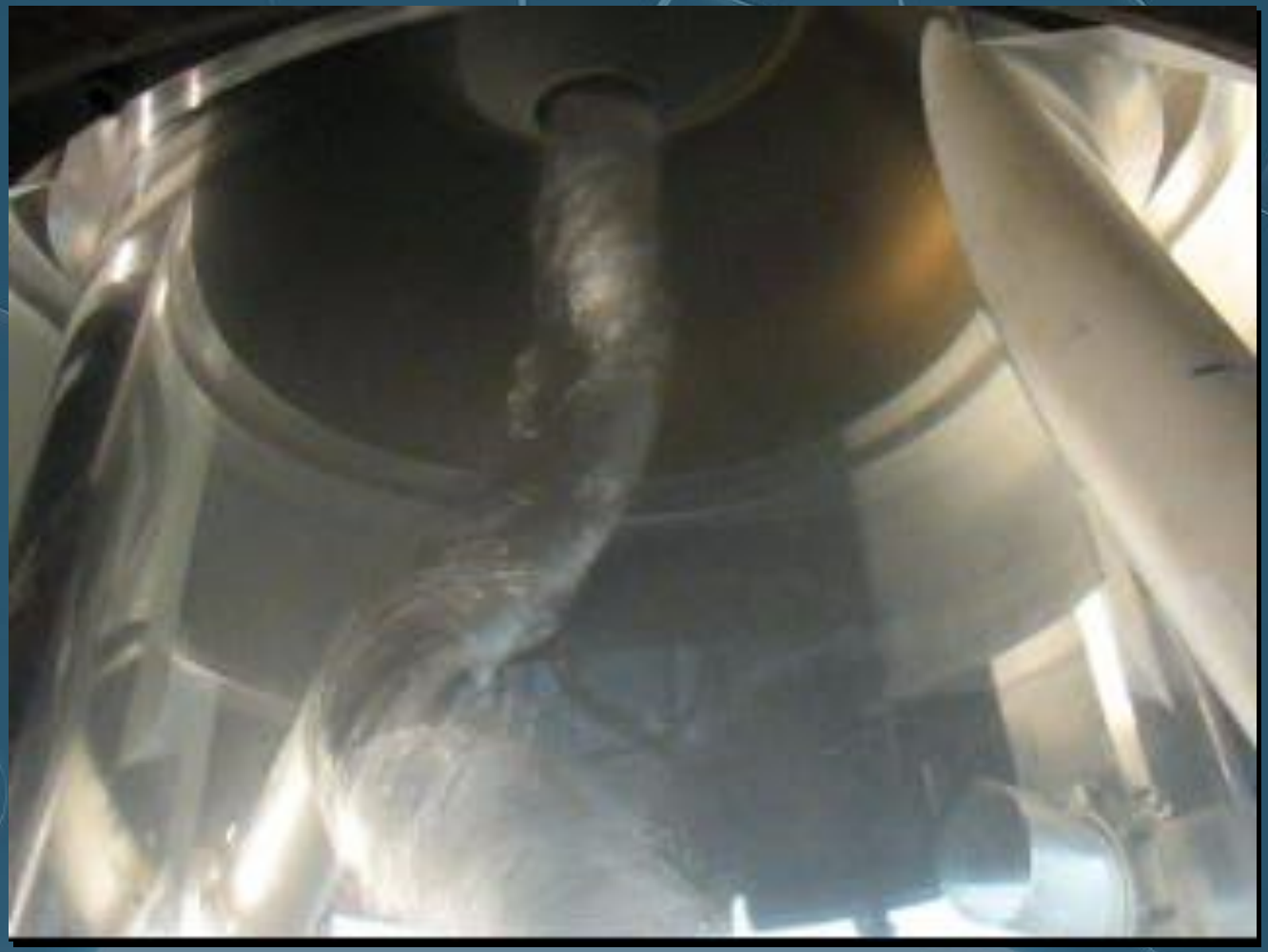
- Generator de curgere cu rotatie similara cu cea din turbinele hidraulice
- Durata: 1 an
- Activitati:
  - Simularea numerica a curgerii si stabilirea cerintelor de proiectare
  - Proiectare traseu hidraulic
  - Proiectare paletaje
  - Executie repere componente
  - Asamblare si testare

4) Finalizarea proiectului

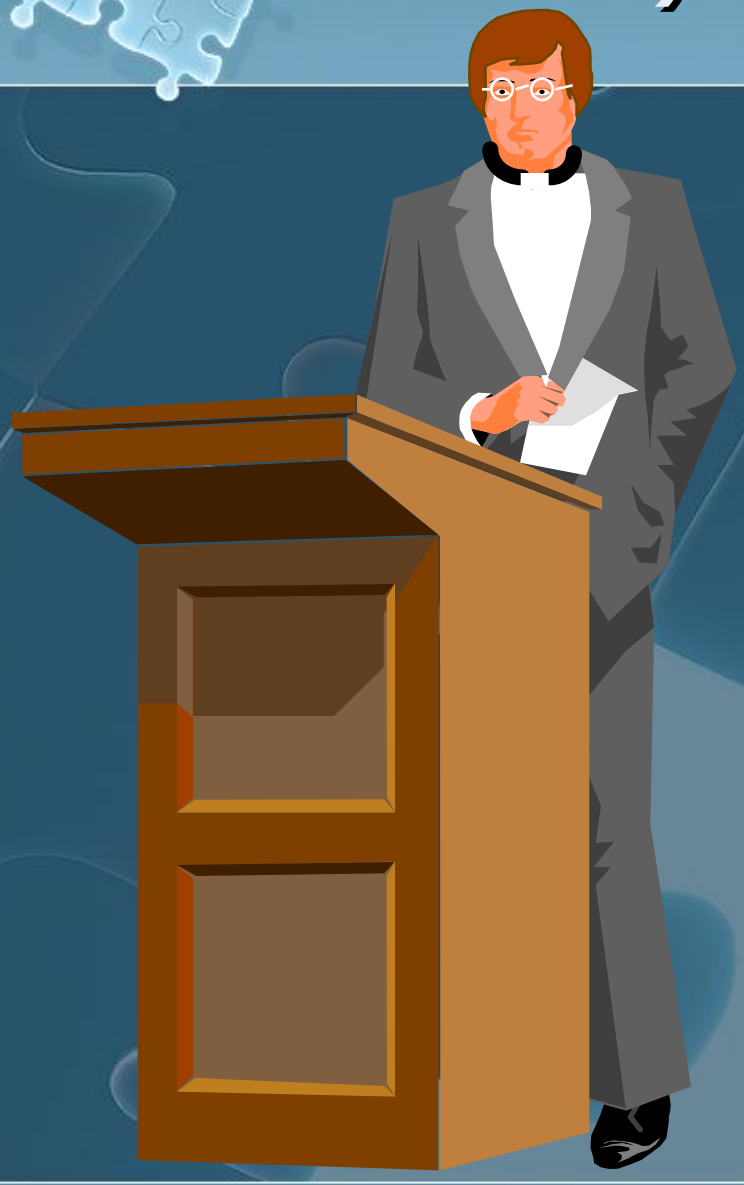


- *Conteaza proiectele terminate, nu cele incepute!*
- Este mult mai atractiv sa proiectezi decat sa realizezi practic (hârtia suportă …)
  - "You can quickly tell whether or not the authors have ever built something and made it work."
- Micsorati proiectul daca este in intirziere
  - "Cresterea echipei unui proiect in intirziere il intirzie si mai mult."
- Finalizarea unui proiect este cea mai buna experienta de alegere inspirata a problemei si gasirea celor mai simple si eficiente solutii

Finalizarea proiectului: satisfactia confirmarii practice a solutiei propuse



5) Diseminare



- Program doctoral → teza de doctorat + rapoarte intermediare de cercetare
- Lucrări stiintifice prezentate la conferinte → dezbaterea in comunitatea stiintifica a rezultatelor obtinute, feedback asupra calitatii si relevantei, sugestii de imbunatatire / continuare a cercetarilor
- Lucrari stiintifice publicate în jurnale de specialitate (archival papers) → recenzie riguroasa, cu referenti anonimi, specialisti in domeniu; rezultate "definitive".

When I submitted my manuscript for publication in a journal, the editor rejected it with the comment "not enough archival contribution" ...

... meaning that your paper does not have enough long-lasting contribution to your field of study. That is, there either is too little contribution at all, or the editor assumed that your paper only has a very temporary contribution which will be outdated soon

Writing is easy …

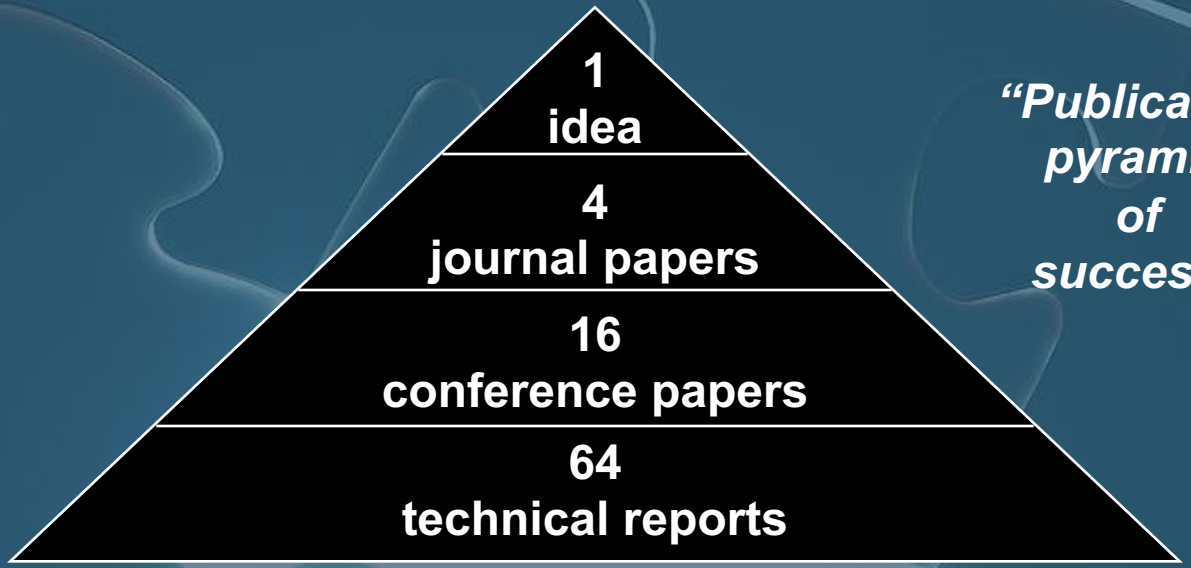
Motto:

"Writing is easy. All you do is stare at a blank sheet of paper until drops of blood form on your forehead"

Gene Fowler (1890-1960)

Tactici gresite de diseminare

https://en.wikipedia.org/wiki/Publish_or_perish



"Publication pyramid of success"

Journal papers

(preferabil doctorandul prim autor)

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Unsteady Pressure Analysis of a Swirling Flow With Vortex Rope and Axial Water Injection in a Discharge Cone

The variable demand of the energy market requires that hydraulic turbines operate at variable conditions, which includes regimes far from the best efficiency point. The vortex rope developed at partial discharges in the conical diffuser is responsible for large pressure pulsations, runner blades breakdowns and may lead to power swing phenomena. A novel method introduced by Resiga et al. (2006, "Jet Control of the Draft Tube in Francis Turbines at Partial Discharge," Proceedings of the 23rd IAHR Symposium on Hydraulic Machinery and Systems, Yokohama, Japan, Paper No. F192) injects an axial water jet from the runner crown downstream in the draft tube cone to mitigate the vortex rope and its consequences. A special test rig was developed at "Politehnica" University of Timisoara in order to investigate different flow control techniques. Consequently, a vortex rope similar to the one developed in a Francis turbine cone at 70% partial discharge is generated in the rig's test section. In order to investigate the new jet control method an auxiliary hydraulic circuit was designed in order to supply the jet. The experimental investigations presented in this paper are concerned with pressure measurements at the wall of the conical diffuser. The pressure fluctuations' Fourier spectra are analyzed in order to assess how the amplitude and dominating frequency are modified by the water injection. It is shown that the water jet injection significantly reduces both the amplitude and the frequency of pressure fluctuations, while improving the pressure recovery in the conical diffuser. [DOI: 10.1115/1.4007074]

Keywords: decelerated swirling flow, vortex rope, water injection method, unsteady pressure, experimental investigation

Journal papers

(preferabil doctorandul prim autor)

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Flow-Feedback Method for Mitigating the Vortex Rope in Decelerated Swirling Flows

When reaction hydraulic turbines are operated far from the design operating regime, particularly at partial discharge, swirling flow instability is developed downstream of the runner, in the discharge cone, with a precessing helical vortex and its associated severe pressure fluctuations. Bosioc et al. (2012, "Unsteady Pressure Analysis of a Swirling Flow With Vortex Rope and Axial Water Injection in a Discharge Cone," ASME J. Fluids Eng., 134(8), pp. 1–11) showed that this instability can be successfully mitigated by injecting a water jet along the axis. However, the jet discharge is too large to be supplied with high pressure water bypassing the runner, since this discharge is associated with the volumetric loss. In the present paper we demonstrate that the control jet injected at the inlet of the conical diffuser can actually be supplied with water collected from the discharge cone outlet, thus introducing a new concept of flow feedback. In this case, the jet is driven by the pressure difference between the cone wall, where the feedback spiral case is located, and the pressure at the jet nozzle outlet. In order to reach the required threshold value of the jet discharge, we also introduce ejector pumps to partially compensate for the hydraulic losses in the return pipes. Extensive experimental investigations show that the wall pressure fluctuations are successfully mitigated when the jet reaches 12% of the main flow discharge for a typical part load turbine operating regime. About 10% of the jet discharge is supplied by the plain flow feedback, and only 2% boost is insured by the ejector pumps. As a result, this new approach paves the way towards practical applications in real hydraulic turbines.
[DOI: 10.1115/1.4023946]

Keywords: decelerated swirling flow, vortex rope, flow-feedback method, experimental investigations, unsteady pressure analysis

6) Transfer tehnologic

- Identificare parteneri industriali pentru implementare soluție tehnică
- Identificare situații practice care pot beneficia de soluția realizată
- Valorificare soluție: preluarea metodologiei / proiectului de către partenerul industrial, în vederea producerii în serie (se cedează dreptul de proprietate intelectuala).
- Contract pentru adaptarea soluției propuse la situațiile practice care o solicită (se pastrează dreptul de proprietate intelectuală).

Howard Aiken, circa 1950:

"The problem in this business isn't to keep people from stealing your ideas; its making them steal your ideas!"

Dacă nu brevetați, o fac alții ... fară rețineri !

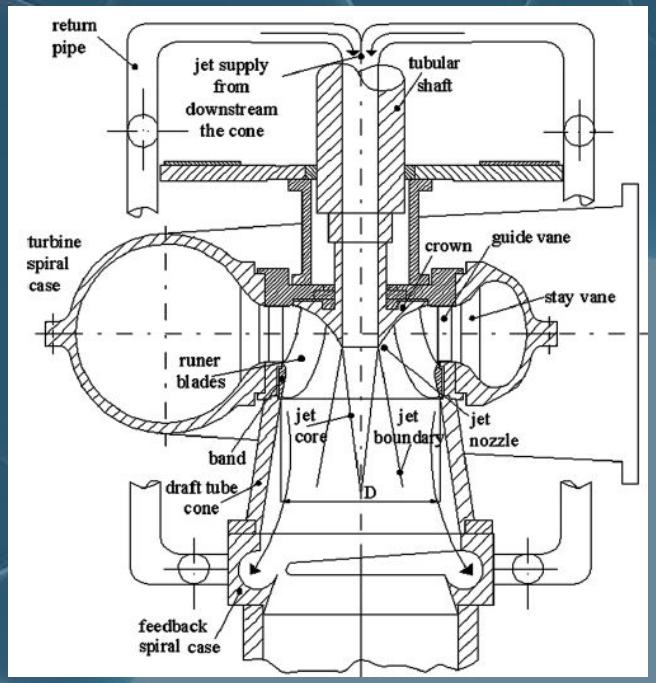
Francis turbine has control valve which is provided in water suction pipe that takes in fluid from curve part of draft tube and discharges fluid to flow path between runner and curve part

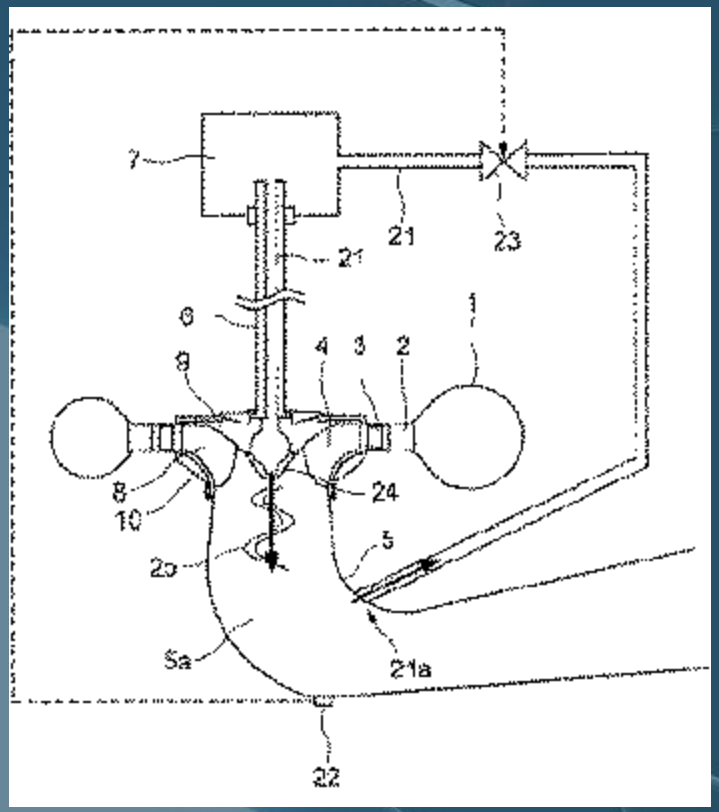
Patent Number(s): JP2013072341-A

Inventor(s): KUROSAWA S, NAKAGAWA N

Patent Assignee Name(s) and Code(s): TOSHIBA KK(TOKE-C)

Derwent Primary Accession Number: **2013**-F80448 [29]





În loc de concluzii ....

"As we think about the plethora of challenges, it is important to remember that students are driven by passion, curiosity, engagement, and dreams",

Charles West, MIT President, 2004