How to Compete and Win Big Grants/Contracts?

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Big Grants?

- Single PI grants typically do not exceed 150k/ year
- Big Grants ~ 2 million/year
- Multiple years 3-5
- Examples: DoD:MURIs, DARPA, IARPA, NSF (STC, ERC), ARL (CRA, CTA), Special initiatives (Manufacturing, Robotics, Textiles)
- Special Initiatives: Do not come every year
- Multidisciplinary
- Multi-institutional

Who Leads?

- Typically Assistant professor do not lead big ones
- Associate professors may lead big ones some times
- Should work on being part of the team; inside or outside institution
- Typically PI of big efforts is a full professor for about 5 years +
- Should be at least in the top 10 in the proposal topic

PI or Team Head?

- Should be seen as a trustworthy person
- Should be someone who gets along with folks
- Should have leadership qualities
- Should have good scholarly reputation

Multi-Disciplinary Research

- Since early 90s, Evolved from University Research Initiatives (URI) to MURIs
- 3 base years + 2 option years
- You compete with the best!
- 1.25 – 1.75 million/year
- Every year 20-30 topics are announced
- Two-stage process
  - White papers (4-5 pages) Typically 15-30 white papers are submitted
  - 5-6 are invited for full proposal
  - 1 is selected. Sometime 2 get selected

Chopra's experience with URI, MURI as PI

- ARO: Center for Rotorcraft Education and Research (1982-2006)
- Army NRTC: Vertical Lift Research Center of Excellence (VLRCOE) (2011-2021)
- ARO: URI: Smart Rotor Development for Vibration Control (1992-97)
- ARO: MURI: Smart Rotor Development of Noise Control (1997-02)
- ARO: MURI: Micro Air Vehicle Development (2004-2009)
- ARL:MAST: Center for Micro Mechanics (2008-2018)
- ARL: CRA: Vertical Lift Platform Concept and Aeromechanics (2015-2020)

Vertical Lift Research Center of Excellence (VLRCOE)

Carry out coordinated 5-year multi-disciplinary research and educational program that will advance fundamental understanding, predictive, and design optimization capabilities in a number of research areas in rotorcraft.
Focus: in-depth fundamental understanding, creativity, and good balance between analysis and experimental testing.

Research Tasks =26
Graduate students = 30+
Faculty members = 20

US Army Technical Monitors:
Dr. Mahendra Bhagwat (AFDD)
Dr. Bill Lewis

Team: New VLRCOE (2016-21)

Alfred Gessow Rotorcraft Center

US Naval Academy

University of Texas at Austin

Texas A&M University

RPI

Technical University Munich

Technion (Israel)

Roma Tre University

Chellappa's experience with URI, MURI

- Center for the Integration of Optical Computing (USC, 1986-1991) Senior investigator
- Computer Vision (1996-2001) Co-PI
- Hyperspectral processing (2002-2007) Interesting story
- MAVs (2004-2009) Senior investigator
- Remote biometrics in the maritime domain (2008-2013) - PI
- Opportunistic sensing (2009-2014) Co-PI
- Rich representations for image understanding (2010-2015) Co-PI
- Actionable Information (2017-2022) Co-PI
- Did not get 4 MURIs (2 as PIs, 2 as Co-PIs)

Antonsen: Experiences with Collaborative Grants

- FY1994 MURI - Pulse shortening in High Power RF sources
- FY1997 MURI - Vacuum Electronic Devices
- FY2001 MURI - Effects of RF pulses on electronics
- FY2013 MURI - Sources for Ionospheric Modification

- ONR 2008 - Center for Applied Electromagnetics
- NSF 2009 - Advanced Accelerators (UCLA, UMD, UTx)
- AFOSR 2014 - Center for Electromagnetic Effects

- + 3 – 4 Unsuccessful attempts

- FY2020 MURI - Waveform control in HPM sources

FY2020 MURI Topics: All DoD

MURI TOPICS:

ONR:

Topic 1: Stimuli-Responsive Materials based on Triggered Polymer Depolymerization
Topic 2: Quantum Benefits without Quantum Fragility: The Classical Entanglement of Light
Topic 3: Mathematical Methods for Deep Learning
Topic 4: Spin and Orbital Angular Momentum (SAM & OAM)
Topic 5: Photonic High-Order Topological Insulators (PHOTIs)
Topic 6: Active Topological Mechanical Metamaterials
Topic 7: Harvesting Oxygen from the Ocean
Topic 8: Exploring Oxidation and Surface Phenomena of Multi-Principal Element Alloys
Topic 9: The Physics of High-Speed Multiphase-flow / Material Interactions
Topic 10: Combining Disparate Environmental Data Into a Common Framework

ARO:

Topic 11: Adaptive and Adversarial Machine Learning
Topic 12: Axion Electrodynamics beyond Maxwell's Equations
Topic 13: Engineering Endosymbionts to Produce Novel Functional Materials
Topic 14: Information Exchange Network Dynamics
Topic 15: Mathematical Intelligence: Machines with More Fundamental Capabilities
Topic 16: Quantum State Engineering for Enhanced Metrology
Topic 17: Solution Electrochemistry without Electrodes
Topic 18: Stimuli-Responsive Mechanical Metamaterials

AFOSR:

Topic 19: Machine Learning and Physics-Based Modeling and Simulation
Topic 20: Fundamental Design Principles for Engineering Orthogonal Liquid-Liquid Phase Separations in Living Cells
Topic 21: Modeling, Prediction, and Mitigation of Rare and Extreme Events in Complex Physical Systems
Topic 22: Fundamental Limits of Controllable Waveform Diversity at High Power
Topic 23: Full Quantum State Control at Single Molecule Levels
Topic 24: Constructive Mathematics and Its Synthetic Concepts from Type Theory
Topic 25: Weyl Fermion Optoelectronics
Topic 26: Mechanisms of Ice Nucleation and Anti-Icing Constructs

How to Win?

- Should be in top 10. Better to be in top 5!
- Collaboration of 3-5 universities
- 10-15 faculty participants in early years
- 5-10 faculty participants now
- Get at least 2-3 star professors in the topic area involved
- PI typically gets 300k. Co-PIs typically share the rest equally.

How to Win?

- Should stress basic research with some transitions (Relevance!!)
- White papers are critical as they decide if a full proposal is warranted
- Good to have some collaborations with relevant DoD labs
- Reviewed by folks from universities, Govt. labs, companies..
- Best grant to win

DARPA

- Organized as offices
- Defense Science Office supports basic research types mostly in math, physics and some engineering
- All other offices, mostly support applied research on very challenging problems
- Announced via Broad Agency Announcements
- White papers followed by full proposals, not always.
- Don’t care much about who you or where your are employed as longs as you have good ideas.
- Transitions are important and valued.

DARPA

- Likes novel, radical ideas.
- Could be 300k/year to 3 million/year
- Could be single PI or multiple PI
- Be prepared for pressure on evaluations, contributing to systems, transitions, etc
- Chellappa: Have been funded by DARPA since 1992, almost without a break
- Helped as UMD was already a DARPA-funded computer vision center since 1976, thanks to Prof. Azriel Rosenfeld

DARPA: How to Win?

- Just convince the program manager.
- Can start with small efforts known as seedlings
- Looks for big DARPA-funded universities in your research area and join them.
- DARPA PMs are busy.
- Practice writing brief white papers emphasizing novel concepts

IARPA

- What DARPA is for military, IARPA is for intelligence community
- Young agency
- Similar to DARPA in many ways
- Likes to make fewer but larger contracts
- Metrics as well as basic science are important
- Not afraid to tackle very difficult problems
- User community impact is very important and cherished

IARPA: How to Win?

- Similar to DARPA
- Convince the program manager
- Seedling efforts can be tried.
- Respond to Broad Agency Announcement
- Novelty is important
- Mission/metric specific proposals are needed
- Reviewed by user community, Govt. scientists
- Three phases, each typically 18 months long
- High pressure to excel
- Teams may be dropped at the end of Phase I or II.
- Experience is like working on a startup
- Join an established IARPA-funded team.

NSF

- Peer-reviewed
- Core programs (small, medium, large)
- Small: Single PI 150k/year for 3-4 years
- Medium: 2-3 PIs. 500k/year for 3-4 years
- Large: 3-4 PIs, 600k/year for 5 years
- Engineering Research Centers: > 3 million/year for 10 years. Participation from companies needed. String educational outreach, diversity of participants, science are all important. For engineers only. ISR started like this.
- Topics are announced.
- Pre-proposals, full proposals, site visits
- 200 to 20 to 10. Pre-proposals are important. Lot of work for the PI.
- 10-20 professors, post docs, graduate and undergraduate students.
- Grand ideas are needed.

NSF

- Science and Technology Centers: For scientists. 5 million/year fro 5 + 5 years. MIT has one.
- More science and engineering or technology.
- Industry participation encouraged.
- All other NSF-style requirements regarding education, outreach and diversity are important.
- Grand ideas are needed!

NSF

- Other special initiatives such as Information Technology Research (ITR), Cybesecurity, cyber-physical systems,..
- The good, bad and ugly sides of peer reviews
- One in 5 for CAREER
- For small proposals 1/8
- For medium 1 or 2 in 20
- For large: Rare

NSF: How to Win?

- Exceptional basic research
- Educational and diversity outreach
- 15 pages of terrific writing. Only 10 pages for new research.
- Prior research record and what you did is helpful
- Start with NSF CAREER and build up
- Reviewed by professors and researchers

DoD large centers

- Army Research Laboratory
- FedLabs (1996-2001)
- Collaborative Technology Alliances (2001-2009) –Sensors, Robotics, Advanced Decision Architectures, Communications
- 2010-2020 – Autonomous systems, network sciences,..
- Newer initiatives are coming up

How to Win?

- Engage ARL scientists and engineers
- Be part of a team
- Pis are well-established researchers
- ARL likes MIT, Harvard, Berkeley, Stanford, Brown..
- Reviewed by various army lab scientists and engineers

Conclusions: Advantages of Major Program

- Significant Funds
- Multiyear-Multidisciplinary
- Major recognition for University (Impact!!)
- Critical mass of faculty in a specific area
- Cost share from campus (travel money, new faculty, fellowships)
- Acts as seed for more research grants/contracts
- Attract outstanding students