Medical Physics Research

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Challenge

- Research requires manpower
  - Grant budgets usually overwhelmingly dominated by salary support
  - Past: clinical funds could support research
  - Present: physics resources strained by reduction in professional revenues, physics shortage
  - Develop funding strategies involving extramural funding

Types of Funding

- Corporate
  - Corporations need and support research by clinics for current and future products
- Non-governmental
  - Charities and foundations
  - e.g. Howard Hughes, American Cancer Society
  - cos.com COS funding alerts
- Governmental
  - State
    - Some states have cancer-related grant programs (tobacco settlements)
  - Federal
    - NIH, DOD, NSF

Corporate

- Spans from fundamental research to beta testing of clinical products
- Most often: research needs to match corporate goals and direction
- Often marketing component to the grant
  - Keep customer happy
  - Show off happy customer to potential customers
    - In person
    - At conferences
  - Develop marketing literature
    - AAPM booths…
- However: Only high quality research and development leads to long-term relationship

Corporate

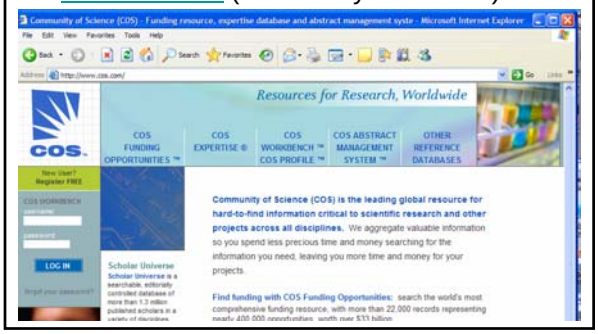
- Types of research
  - Fundamental (e.g. radiobiology)
  - Product development (e.g. new phantom)
  - Beta testing
- Important considerations
  - Intellectual property takes longer than research plan
  - Personal relationships are important
  - Effective and regular communication
  - More unstable than governmental grants
    - Change in company priority
    - Change in company fortunes

Corporate

- Applications are much shorter (page/$)
- Rigorous scientific approach, clarity in presentation not as important as governmental grants
  - Direct communications
- Scientific record not as important

Non-Governmental

- www.cos.com (community of science)



Governmental

- DOD
- **NIH**
- NSF

Summary

- NIH:
  - Two organizations/processes
    - Funding institutes (http://www.nih.gov/icd/)
      - E.g. NCI, NIBIB, National Heart Lung and Blood Ins.
    - CSR (Center for Scientific Review) (http://www.csr.nih.gov/committees/rosterindex.asp)
  - Process – Submit grant to CSR, reviewed and prioritized (score). If funding is sufficient, the funding institute will fund the grant. If not, you will receive a written critique and allowed to resubmit up to 2X.

Quick Links

OD	NIDA
NCI	NIEHS
NEI	NIGMS
NHLBI	NIMH
NHGRI	NINDS
NIA	NINR
NIAAA	NLM
NIAID	CIT
NIAMS	CSR
NIBIB	FIC
NICHD	NCCAM
NIDCD	NCMHD
NIDCR	NCRR
NIDDK	CC

Summary (2)

- Mechanisms (for independent investigators)
  - R01 – main independent investigator driven grant
  - R21 – innovative research (2 years, limited funding)
  - R21/R33 – innovative research
  - STTR/SBIR (R41/R42 and R43/R44)
- Institutes participate in proactive funding announcements
  - PA, RFA (http://grants1.nih.gov/grants/guide/index.html)
- Grants email announcement services
- Scores and "Triage", percentiles, funding lines

- NSF (http://nsf.gov/funding/)
- DOE (http://www.science.doe.gov/grants/)
  - Breast and Prostate
- Jim Deye (Program Director in Radiation Research Program at NCI)
  - Funding at NIH
  - Wednesday at 7:30 am

NIH Grant

- Schedule
- R01 Structure
- Post Submission
- General
- Tips

Schedule

- Idea (hypothesis) (year 0)
- Generate preliminary data (year 0.5)
  - Seed funding
  - Build research group
    - Usually cannot do it on your own
- Prepare application (year 0.7)
  - Submit application
- Application reviewed/scored (year 0.9)
- Funded: starts year 1.2
- Not funded:
  - Application critique received (year 1.2)
  - New data/new text (year 1.3)
  - Resubmission (year 1.5)
- Clearly: Long term process requiring long-term planning

R01 Structure

- Grant writing is different than a manuscript
- First Person Plural
- Active tense

We conducted preliminary studies to evaluate the utility of breathing motion artifact removal on quantitative PET delineation of tumor boundaries, including addressing surface delineation thresholds.[99,100] A cylindrical phantom (Figure 5a) was filled with an ^{18}F solution (initial activity of 0.33 μCi·ml^{-1}) and three spherical target airflow) using a series of gating window sizes from 4.0 mm through 1.0 mm. The tumor trajectory and window sizes define the tidal volume phase space windows (Figure 11). We will then examine the remaining motion trajectories and compare the spatial extents of them to the tumor to determine if the residual blurring of the PET image in those regions is clinically significant.

- Tell a story
- Refer sections and concepts back to specific aims

§B.9: Dynamic PET (SA2 and SA3)

The concept of gating PET/CT units to remove breathing artifacts was pioneered by the Memorial Sloan Kettering group.[19,89] Reports by Erdi *et al.*[19] and Nehmeh *et al.*[89,90] described a method for producing PET

NIH R01 Application Structure

- A) Specific Aims
- B) Background and Significance
- C) Preliminary Data
- D) Research Design and Methods
- 25 pages

A) SPECIFIC AIMS

The overall hypothesis of this project is that the local control or reduced morbidity levels, by advances in the image seg

B) BACKGROUND AND SIGNIFICANCE

B1. Introduction

The conformal radiation therapy process, including the use o volumetric CT scans to determine the shape and size of no

C) PRELIMINARY DATA

C1. Segmentation Process (SA1)

C1.1 Geometric Shapes

The surface segmentation generation process has been prot investigator (see §D2) and prototyped in Mathematica. An e ellipsoid (3.5 cm x 4.5 cm x 6.0 cm) is shown in Figure 2. Two

D) RESEARCH DESIGN AND METHODS

D1. Process Description

A brief description of the clinical application of the propo research plan. When this process is implemented in the c high-spatial resolution CT for segmentation. A lower-resol

Specific Aims

- Hypothesis driven
- Specific
- Provable
- Justified by preliminary data
- Tied to each other

Specific aim 2: We will demonstrate that quantitative PET images both inside and outside the lungs can be generated for each phase of quiet respiration.

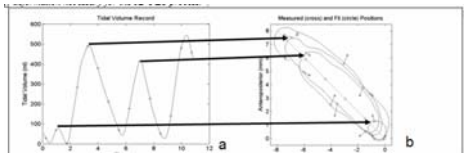
Hypothesis: *Accurate PET diagnostic images in the presence of quiet respiration can be generated by retrospective gating of event data in quantitative spirometry-measured tidal-volume phase space.* Using a multislice PET/CT, a quantitative spirometry-correlated 5D-CT dataset will be generated to provide the trajectories of the tumor, lungs, and other thoracic and upper abdominal organs as functions of tidal volume and airflow (breathing phase). The PET scan will be acquired while the patient undergoes the same quantitative breathing measurements used in the 5D-CT process. The tidal-volume phase space will be subdivided into

Background and Significance

- Not a literature review
- Each paragraph should build a logical rationale for the grant
- Typically use to justify what has already been done that precedes and backs-up the grant
- Evaluates and criticizes competing approaches
  - Remember that the authors may be reviewers so be polite and objective!

Preliminary Data

- Support the specific aims
- Show the reviewers that you know how to do what you are proposing to do
- Can be published or unpublished.



Research Design and Methods

- Bulk of grant
- State what you are going to do
- Have backup plans (plan Bs)
  - What you will do if one of the subaims does not work out
- Connect back to specific aims

motion trajectories will be determined relative to the reference breathing phase.

§D.2.e: Breathing and Gating Model (SA2 and SA3)

The breathing motion model described in §C.2 along with automated deformable registration techniques described in §D.1 will be used to model the breathing motion. This will be accomplished by conducting accurate deformable registration on the 5D-CT images to determine the location of anatomical features in each

Post-Submission

- Continue to work on grant project
- Present at conferences
  - Reviewers are medical physicists too
  - Opportunity for them to see more detail on grant subject
  - Shows commitment of PI and institution for project (good investment)
  - Shows your expertise on subject
- Provides additional data for subsequent submissions

Post-Submission

- Supplemental data
  - At discretion of SRA
  - Typically 1 month before study section meets
  - Often 3 pages of new data
  - New published journal articles
  - This helps to show
    - New results that justify specific aims
    - Continued commitment to project

General

- Grants are very public
  - In theory: score and outcome private
  - In practice: everyone finds out how you did
- Thick skin
  - Critique is usually objective, but it may comment on qualifications of PI
- Persistence
  - Scores often improve
  - Critiques provide guidance on how to proceed

Tips

- Know the appropriate Study Section and Appropriate Program Directors at Institutes
- Know the membership of the Study Section
- Revise, Revise, Revise
- Be persistent (3 submissions)
  - Understand the review response process
- Submit to more than one agency (e.g. DOE and NIH)

Suggested Web Sites

- http://www.grants.gov/
- http://grants1.nih.gov/grants/oer.htm
- http://imaging.cancer.gov/researchfunding/current/currentfunding
- http://www.becon.nih.gov/becon_funding.htm
- http://imaging.cancer.gov/researchfunding/mechanisms
- http://imaging.cancer.gov/researchfunding/
- http://www.cancer.gov/researchandfunding
- http://crisp.cit.nih.gov/