

: BIOMEDICAL IMAGE COMPUTING, MS

In Workflow

1. U Program Review (dforgacs@illinois.edu; eastuby@illinois.edu; aledward@illinois.edu)
2. 1343 Head (maa@illinois.edu; gunderhi@illinois.edu; smi@illinois.edu)
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9. Senate (jtempel@illinois.edu)
10. U Senate Conf (none)
11. Board of Trustees (none)
12. IBHE (none)
13. DMI (eastuby@illinois.edu; aledward@illinois.edu; dforgacs@illinois.edu)

Approval Path

1. Thu, 21 May 2020 15:14:15 GMT
Deb Forgacs (dforgacs): Approved for U Program Review
2. Thu, 21 May 2020 17:00:27 GMT
Mark Anastasio (maa): Approved for 1343 Head
3. Thu, 21 May 2020 20:34:54 GMT
Keri Pipkins (kcp): Rollback to 1343 Head for KP Committee Chair
4. Wed, 27 May 2020 20:41:39 GMT
Mark Anastasio (maa): Approved for 1343 Head
5. Fri, 30 Oct 2020 21:11:53 GMT
Keri Pipkins (kcp): Approved for KP Committee Chair
6. Fri, 30 Oct 2020 21:22:44 GMT
Candy Deaville (candyd): Approved for KP Dean
7. Fri, 30 Oct 2020 21:24:45 GMT
John Wilkin (jpwilkin): Approved for University Librarian
8. Fri, 11 Dec 2020 20:45:40 GMT
Allison McKinney (agrindly): Approved for Grad_College
9. Sun, 13 Dec 2020 23:26:03 GMT
Kathy Martensen (kmartens): Approved for Provost

New Proposal

Date Submitted: Tue, 19 May 2020 14:52:00 GMT

Viewing:: Biomedical Image Computing, MS

Changes proposed by: Maddie Darling

Proposal Type

Proposal Type:

Major (ex. Special Education)

Proposal Title:

If this proposal is one piece of a multi-element change please include the other impacted programs here. *example: A BS revision with multiple concentration revisions*

We are proposing a new program - the Master of Science in Biomedical Image Computing in the Department of Bioengineering.

EP Control Number

EP:21.040

Official Program Name

Biomedical Image Computing, MS

Effective Catalog Term

Fall 2021

Sponsor College

Grainger College of Engineering

Sponsor Department

Bioengineering

Sponsor Name

Mark Anastasio

Sponsor Email

maa@illinois.edu

College Contact

Harry Dankowicz

College Contact Email

danko@illinois.edu

Program Description and Justification

Provide *abrief* description and justification of the program, including highlights of the program objectives, and the careers, occupations, or further educational opportunities for which the program will prepare graduates, when appropriate.

Biomedical image computing is a large, rapidly growing industry and research field comprising the formation and analysis of diagnostic images. Both image system design and biomedical image analysis currently are being revolutionized at a tremendous rate by the emergence of machine learning techniques. The proposed Master of Science (MS) degree addresses the unmet need for efficient, rigorous training focused at the intersection of biomedical imaging science and machine learning. The Bioengineering department (BIOE) will offer a non-thesis, self-funded, MS degree to be completed in three semesters of full-time study. The three main distinctions of the proposed program from existing ones are: 1) instant and complete immersion in the burgeoning field of imaging science, 2) a sustained and streamlined practicum in modern machine learning techniques, and 3) a new curriculum that is integrated a priori with the explicit purpose of efficient training in solving real imaging science problems via machine learning.

The purposeful design of an innovative curriculum that blends machine learning with imaging science is the unique feature that distinguishes this Grainger College of Engineering (Grainger Engineering) program from all others. Education in machine learning is handled traditionally as a track or concentration in computer science (CS) departments; however, these relatively broad programs often give little to no coverage of the specialized domain knowledge required to handle medical images or biological image data. These data are from, or for, real people and thus there are unique challenges to ensuring that people do not suffer the mistakes of a computer. Biomedical imaging and image analysis is a mission-critical application of machine learning that requires focused and specialized training not usually found in other departments. BIOE currently has 10 faculty members actively working with a wide range of modern biomedical imaging modalities in real, well-funded imaging applications. The proposed program hosted in BIOE, led by our experts in imaging and applied machine learning, precisely provides the necessary training in a timely manner.

The demand in industry for engineers who are trained at the confluence of biomedical imaging and machine learning is unmet. The proposed degree program will meet this need directly and provide value to students and employers. Graduates from the degree program will find careers as engineers who are developing, translating, and evaluating biomedical imaging technologies that exploit machine learning methods. Moreover, certain graduates may follow similar career paths in related industries focused on medical applications of imaging. The proposed degree is central to the scholarly mission of BIOE and Grainger Engineering. As such, the proposed degree will generate significant revenue while promoting high-quality scholarship that is consistent with the values of our department and college. The degree also will serve to build synergies within our college and across campus.

The proposed degree program is expected to attract a wide range of students who have an engineering or other quantitative undergraduate degrees but may lack advanced training in imaging science and machine learning. The degree program will provide these students with a cutting edge training in these topics that will subsequently provide enhanced job opportunities for them. Boot camps on intermediate and advanced Python programming and data science tools will be made available to the students to enable them to succeed in the program.

Corresponding Degree

MS Master of Science

Is this program interdisciplinary?

No

Academic Level

Graduate

Will you admit to the concentration directly?

No

Is a concentration required for graduation?

No

CIP Code

140501 - Bioengineering and Biomedical Engineering.

Is This a Teacher Certification Program?

No

Will specialized accreditation be sought for this program?

No

Institutional Context

University of Illinois at Urbana-Champaign

Describe the historical and university context of the program's development. Include a short summary of any existing program(s) upon which this program will be built.

Explain the nature and degree of overlap with existing programs and, if such overlap exists, document consultation with the impacted program's home department(s).

The proposed program is grounded in, and blends together, two research strengths of Grainger Engineering: biomedical imaging science and machine learning. Biomedical imaging research at Illinois has a rich heritage that includes the development of magnetic resonance imaging, fundamental contributions to biomedical acoustics and optics, and computational imaging. Imaging is the largest research area in the Department of Bioengineering. The department possesses longstanding programmatic collaborations with colleagues in the Department of Electrical and Computer Engineering (ECE) who also work on biomedical imaging. These colleagues contributed to the proposed program development and will be invited to participate in our program committee described below. Machine learning and computational science research are also storied here at Illinois. This solid foundation of scholarship and directly relevant expertise will facilitate the implementation of the proposed MS degree in Biomedical Image Computing. Illinois is ideally suited to assume a leadership role in computational bioimaging education and will rapidly receive international recognition for doing so.

University of Illinois

Briefly describe how this program will support the University's mission, focus and/or current priorities. Demonstrate the program's consistency with and centrality to that mission.

The proposed degree will support the university's mission and is aligned with current priorities. The degree will provide directly applicable training in biomedical imaging and machine learning that is in high demand from industry. Data regarding industry demand and career opportunities are provided in the "Market Demand" section of this proposal. This is consistent with the university's mission to provide technical education to people of the state of Illinois and across the globe. Facilitated by their cutting-edge skills and knowledge, graduates of the program will serve to fuel economic growth within the state and across the country.

Biomedical image computing is an area that is aligned with many current priorities of Grainger Engineering and the university. Directly relevant campus or college initiatives include:

- a) Growth of the Carle Illinois College of Medicine
- b) Cancer Center at Illinois
- c) Health Care Engineering Systems Center
- d) Mayo Clinic & Illinois Alliance
- e) Expansion of deep learning major research instrumentation at NCSA
- f) Illinois Data Science Initiative
- g) Discovery Partners Institute

State of Illinois

Indicate which of the following goals of the Illinois Board of Higher Education's Strategic Initiative are supported by this program: (choose all that apply)

High Quality Credentials to Meet Economic Demand - Increase the number of high-quality post-secondary credentials to meet the demands of the economy and an increasingly global society.

Integration of Educational, Research and Innovation Assets - Better integrate Illinois' educational, research and innovation assets to meet economic needs of the state and its regions.

Describe how the proposed program supports these goals.

There is an unmet demand in the biomedical imaging industry for personnel who are trained in biomedical imaging and machine learning principles. By incorporating feedback from industry and our program faculty, the curriculum of the proposed MS degree has been purposefully designed to meet this demand. Namely, students will be concurrently trained in fundamental imaging principles and modern machine learning in a way that traditional programs do not achieve.

This program is to be both a hub and catalyst for academic and industry collaboration. The avenue of collaboration extends to industry via our required capstone projects. While these projects need not be publishable or perfectly novel, they will involve experiences that are highly relevant to industry. The mandate for the capstone projects is genuine applicability and practical technique. We envision that, by solving actual problems posed by industry partners, students at least will gain marketable experience but, ideally, also will make inroads with their future employers via interactions with their faculty and industry project mentors.

Admission Requirements

Desired Effective Admissions Term

Fall 2021

Provide a brief narrative description of the admission requirements for this program. Where relevant, include information about licensure requirements, student background checks, GRE and TOEFL scores, and admission requirements for transfer students.

Applicants to the program must hold a minimum of a baccalaureate degree from an accredited college or university. Applicants will be expected to possess an undergraduate education in an engineering or other quantitative discipline. Applicants should have a minimum grade point average of 3.00 (A = 4.00) or equivalent for the last two years of undergraduate study and show evidence of strong quantitative skills and serious interest in imaging and machine learning through their personal statement.

Describe how critical academic functions such as admissions and student advising are managed.

A program committee will be established to administer the MS program. This committee will consist of tenured or tenure-track faculty members in the Department of Bioengineering including affiliate members from across Grainger Engineering who are engaged in computational biomedical imaging research and/or biomedical data analytics. This committee will be responsible for making admissions decisions and the day-to-day management and maintenance of the academic aspects of the MS program. A Program Director will be appointed to chair this committee.

The Program Director will be responsible for advising students on academic issues and monitoring their progress. It should be noted that the curriculum for the program contains a collection of courses that are largely prescribed, so the advising process should not be burdensome.

Enrollment

Number of Students in Program (estimate)

Year One Estimate

16

5th Year Estimate (or when fully implemented)

40

Estimated Annual Number of Degrees Awarded

Year One Estimate

0

5th Year Estimate (or when fully implemented)

40

What is the matriculation term for this program?

Fall

What is the typical time to completion of this program?

3 Semesters

What are the minimum Total Credit Hours required for this program?

36

Delivery Method**This program is available:**

On Campus

Budget**Will the program or revision require staffing (faculty, advisors, etc.) beyond what is currently available?**

Yes

Please explain/describe:

Although the Department of Bioengineering immediately could accommodate a small cohort of students in the proposed program, the projected steady-state enrollment would place undue burden on current faculty and staff. We intend to fill two new tenure-track faculty positions before the program starts. The department has submitted an Investment for Growth (IFG) proposal to the campus to fund these positions. If the IFG proposal is not selected for funding, the Department of Bioengineering will still move forward with the needed faculty hires. In that case, the hiring commitments will be met by use of the faculty hiring lines already committed to Dr. Anastasio by Grainger Engineering as part of his recruitment as department head.

In addition to the two new faculty hires, existing faculty in the Department of Bioengineering will contribute to the teaching needs of the program. Dr. Frank Brooks will teach two courses. Since his hiring last year, Dr. Brooks' teaching obligations to the department have been fulfilled by his efforts related to program development (including this one). With consideration of this and the two to-be-hired faculty, there will be, in effect, three new faculty available to contribute to the proposed program. The Department of Bioengineering will also be hiring in several other areas over the coming years. As new faculty join the department, this will permit the realignment of some of the teaching assignments of the department's imaging faculty to support the proposed degree program.

As such, due to these available resources and the Department of Bioengineering's commitment to invest in the area of biomedical image computing, the proposed degree program will receive the staffing needed for its success. In fact, the department has already begun faculty recruiting in areas that are directly relevant to the proposed program.

For the first two years, while the program is ramping up, we will leverage our existing staff to support the administrative needs of the program. We will also work with Professor Dankowicz to leverage Grainger Engineering's Graduate Program Office shared-service staff to provide additional support as necessary. In year 3, using program revenue, we will hire a new staff position at the coordinator level. This person would oversee the marketing, budgeting, and other day-to-day business of running the program.

Attach File(s)

MS Biomedical.pdf

Resource Implications

Facilities

Will the program require new or additional facilities or significant improvements to already existing facilities?

No

Technology

Will the program need additional technology beyond what is currently available for the unit?

No

Non-Technical Resources

Will the program require additional supplies, services or equipment (non-technical)?

No

Resources

For each of these items, be sure to include in the response if the proposed new program or change will result in replacement of another program(s). If so, which program(s), what is the anticipated impact on faculty, students, and instructional resources? Please attach any letters of support/ acknowledgement from faculty, students, and/or other impacted units as appropriate.

Faculty Resources

Please address the impact on faculty resources including any changes in numbers of faculty, class size, teaching loads, student-faculty ratios, etc. Describe how the unit will support student advising, including job placement and/or admission to advanced studies.

We intend to fill two new tenure-track faculty positions that can contribute to the teaching needs of the proposed program before the program starts. Additional details were provided in the budget description.

There will be no impact on teaching loads for any of our faculty. As biomedical imaging is already a significant focus in the Department of Bioengineering, the new courses developed for the program will be made available to students outside of the new program. The new courses will satisfy the teaching load requirements of the faculty in the same way that any of the existing BS, MS or PhD courses within the department do.

The unit will appoint a Program Director who will be responsible for advising students on academic issues and job or PhD program placement and also will monitor their progress in the program. It should be noted that the curriculum for the program contains a prescribed set of courses, so the advising process should not be burdensome.

Job placement opportunities will be further enhanced by the establishment of an external advisory board populated by prominent experts in industries that employ biomedical image computing. Through the proposed capstone course and other interactions, students in the program will be exposed

to these experts, many of whom we expect to be interested in recruiting our students. We envision that by solving actual problems in the capstone course posed by industry partners, students will gain marketable experience and make inroads with future employers.

Library Resources

Describe your proposal's impact on the University Library's resources, collections, and services. If necessary please consult with the appropriate disciplinary specialist within the University Library.

No impact anticipated.

Instructional Resources

Will there be any reduction in other course offerings, programs or concentrations by your department as a result of this new program/proposed change?

No

Does the program include other courses/subjects impacted by the creation/revision of this program?

Yes

Required courses

ECE 534 - Random Processes
ECE 543 - Statistical Learning Theory
ECE 547 - Topics in Image Processing
ECE 549 - Computer Vision
ECE 558 - Digital Imaging
ECE 564 - Modern Light Microscopy
ECE 561 - Statistical Inference ENG & DS
ECE 569 - Inverse Problems in Optics
ECE 580 - Optimiz by Vector Space Methds
CS 543 - Computer Vision
CS 547 - Deep Learning
ECE 544 - Topics in Signal Processing

Explain how the inclusion or removal of the courses/subjects listed above impacts the offering departments.

These courses are included in the Program of Study as Approved Electives. Only one elective course is required to meet degree requirements.

The Department of Electrical and Computer Engineering (ECE) offers coursework in biomedical imaging. There is the potential to cross-list at least one of the courses for the proposed program with ECE, but there will be no significant redundancy between the new and existing courses. ECE and also the Departments of Computer Science and Statistics offer courses on topics related to machine learning. However, they all lack the purposeful integration of biomedical imaging with machine learning, which is the hallmark of the proposed degree.

Attach letters of support from other departments.

MS Degree Proposal.pdf
MS BIC-CS Letter of Support.pdf

Financial Resources

How does the unit intend to financially support this proposal?

As described in the budget section, the unit will support the new degree through strategic hiring of faculty as supported by existing commitments from Grainger Engineering. For the first two years, while the program is ramping up, we will leverage our existing staff to support the administrative needs of the program. We will also work with Professor Dankowicz to leverage Grainger Engineering's Graduate Program Office shared-service staff to provide additional support as necessary. In Year 3, using program revenue, we will hire a new staff position at the coordinator level. This person would oversee the marketing, scheduling, budgeting and other day-to-day business of running the program.

Will the unit need to seek campus or other external resources?

No

Are you seeking a change in the tuition rate or differential for this program?

No

Is this program requesting self-supporting status?

Yes

Market Demand

What market indicators are driving this proposal? If similar programs exist in the state, describe how this program offers a unique opportunity for students:

The world market for machine learning/artificial intelligence (AI) in medical imaging, comprising software for automated detection, quantification, decision support, and diagnosis, is set for a period of robust growth and is forecast to top \$3.5 billion in revenue by 2027 ["Machine Learning in Medical Imaging, www.signifyresearch.net] The market growth can primarily be attributed to factors such as expanding the range of applications of AI, shortage of healthcare workforce, and huge R&D investments.

In a job search conducted on indeed.com on January 15, 2020, 2,253 jobs postings were listed that contained the words "image" and "machine learning". Of these, 1494 had a posted salary of at least \$90,000 and 1865 had a salary of at least \$70,000. A narrowed search that contained the words "medical image" and "machine learning" yielded 548 job postings of which 283 had a posted salary of at least \$100,000.

To our knowledge, there are only two slightly similar graduate programs in the country, but neither offer the same blended curricula and neither are purposely designed to be completed in one year. Those programs are aimed at PhD-level research. Given the demand for training in all fields related to diagnostic imaging, modern image analysis, and in real-world machine learning applications, immediate and sustained enrollment is expected.

What type of employment outlook should these graduates expect? Explain how the program will meet the needs of regional and state employers, including any state agencies, industries, research centers, or other educational institutions that expressly encourage the program's development.

As indicated above by the market demand, the employment outlook for graduates of the proposed program is robust. The creation and analysis of image data is playing an increasingly important role, not just in biomedicine, but in many aspects of modern life. The significant demand in industry for engineers who are trained at the confluence of imaging science and machine learning is unmet. Examples of specific job titles in this space found on indeed.com include "Medical Imaging Deep Learning Scientist" and "Imaging Scientist, Deep Learning", and "Computational Imaging Engineer", to name a few.

Due to the proposed curriculum that purposely integrates biomedical imaging and machine learning fundamentals, the proposed degree program will meet this need directly and provide immediate value to students and employers. In response to feedback from industry, the curriculum will contain hands-on experiences with computational imaging and machine learning – throughout the duration of the program – that involves real-world data and problems. The students will also receive training in the salient aspects of high-performance computing that will enable them to be productive.

What resources will be provided to assist students with job placement?

The unit will appoint a Program Director who will be responsible for advising students on employment or PhD program placement. Additionally, Engineering Career Services is an existing service for Grainger Engineering students.

Program Regulation and Assessment

Briefly describe the plan to assess and improve student learning, including the program's learning objectives; when, how, and where these learning objectives will be assessed; what metrics will be used to signify student's achievement of the stated learning objectives; and the process to ensure assessment results are used to improve student learning. (Describe how the program is aligned with or meets licensure, certification, and/or entitlement requirements, if applicable).

The MS program in Biomedical Image Computing is being created to rigorously train students in biomedical imaging science and machine learning; beginning with foundational coursework that builds into a curriculum comprised of in-depth statistical and deep learning for biomedical imaging applications. The program will culminate with a capstone project in which students will develop and implement machine learning solutions to real-world problems in biomedical imaging.

Student learning objectives will be as follows:

- Ability to apply quantitative skills, engineering principles, and computational principles to propose novel and practical solutions to biomedical imaging problems
- Ability to recognize and understand professional and ethical responsibilities
- Ability to identify and communicate real-world biomedical imaging problems with bigger vision and offer solutions, as well as their impact, effectively to a diverse audience and stakeholders, both orally and in writing
- Ability to develop effective leadership skills in order to foster the ability to collaborate and work with a diverse team, which is essential for a career in either academia or industry

Student learning objectives will be assessed in a variety of ways, including:

- Coursework performance
- Presentations on capstone projects
- Capstone mentor feedback
- Progress meetings with the Program Director
- Exit interviews/survey
- Job/graduate school placement data

Students who elect to participate in the optional boot camp will take an exam at the end, strictly to determine baseline knowledge in Python programming concepts and data science tools. The results of this exam will be compared to coursework performance throughout the program, in an effort to track learning progress through the program. The capstone projects will be assessed based on the rigor of the evaluation studies and quality of the final presentation and report. The Program Director will hold mandatory advising meetings throughout the program and conduct exit interviews with each student at the end of the program. At the end of the program, students will also complete an anonymous online exit survey with questions pertaining to their level of preparation for either additional graduate study or their career. The program's governing committee, led by the Program Director, will convene at the end of each year to review the surveys and propose program modifications, if needed, based on student feedback. Job placement data will also be reviewed on an annual basis by the program committee, via responses to required Graduate College surveys and the Illini Success Survey.

This program does not involve licensure, certification, and/or entitlement requirements.

Is the career/profession for graduates of this program regulated by the State of Illinois?

No

Program of Study

"Baccalaureate degree requires at least 120 semester credit hours or 180 quarter credit hours and at least 40 semester credit hours (60 quarter credit hours) in upper division courses" (source: <https://www.ibhe.org/assets/files/PrivateAdminRules2017.pdf>). For proposals for new bachelor's degrees,

if this minimum is not explicitly met by specifically-required 300- and/or 400-level courses, please provide information on how the upper-division hours requirement will be satisfied.

All proposals must attach the new or revised version of the Academic Catalog program of study entry. Contact your college office if you have questions.

For new programs, attach Program of Study

AcademicCatalog_MS_BiomedicalImageComputing_v2.pdf

Catalog Page Text

Catalog Page Text: Description of program for the catalog page. This is not official content, it is used to help build the catalog pages for the program. Can be edited in the catalog by the college or department.

bioengineering.illinois.edu

Head of Department: Mark Anastasio
Associate Head of Graduate Programs: Gregory Underhill
1240 Everitt Laboratory
1406 W. Green St.
Urbana, IL 61801
(217) 333-1867
E-mail: bioe-gradprograms@illinois.edu

Major: Biomedical Image Computing
Degree Offered: M.S.

Graduate Degree Programs

The M.S. in Biomedical Image Computing blends together the fields of biomedical imaging science and machine learning. Students will receive a rigorous training in imaging systems and analysis, computational imaging, and machine learning, in preparation for an industry career.

Admission

Applicants should have a bachelor's degree in an engineering or other quantitative discipline from an accredited college or university. Students should have a minimum grade point average of 3.00 (A=4.00) or equivalent for the last two years of undergraduate study and show evidence of strong quantitative skills and of serious interest in imaging and machine learning through their personal statement. Students in the program do not have automatic admission to the Ph.D. program in any engineering department.

All applicants whose native language is not English must submit a minimum TOEFL score of 102 (iBT), 257 (CBT), or 613 (PBT); or minimum International English Language Testing System (IELTS) academic exam scores of 7.0 overall and 6.0 in all subsections. Applicants may be exempt from the TOEFL if certain criteria are met. Applicants with lesser scores may still apply. Limited status is granted for lesser scores and requires enrollment in English as a Second Language (ESL) courses based on an ESL Placement Test (EPT) taken upon arrival to campus.

Financial Aid

The tuition and fees for the M.S. in Biomedical Image Computing are the standard Graduate and Professional Programs rates for the College of Engineering. Students in the M.S. in Biomedical Image Computing program are not eligible for tuition-waiver generating assistantships.

Statement for Programs of Study Catalog

Code	Title	Hours
Core Coursework		
BIOE 483	Biomedical Computed Imaging Systems	4
BIOE 484	Statistical Analysis of Biomedical Images	4
BIOE 485	Computational Mathematics for Machine Learning and Imaging	4
BIOE 486	Applied Deep Learning for Biomedical Imaging	4
BIOE 488	Applied High-Performance Computing for Imaging Science	3

BIOE 489	Regulations, Ethics and Logistics in Biomedical Applications of Machine Learning	4
BIOE 580	Foundations of Imaging Science	4
BIOE 588	Biomedical Image Computing Capstone Project Literature Review	1
BIOE 589	Biomedical Image Computing Capstone Project	4

Choose one of the following: 4

BIOE 586	Deep Generative Models in Bioimaging	
	OR	

Approved Elective Course (see below)

Approved Elective Courses:

BIOE 505	Computational Bioengineering	
BIOE 507	Advanced Bioinstrumentation	
BIOE 597	Individual Study	
CS 543	Computer Vision	
CS 547	Deep Learning	
ECE 534	Random Processes	
ECE 543	Statistical Learning Theory	
ECE 544	Topics in Signal Processing	
ECE 547	Topics in Image Processing	
ECE 549	Computer Vision	
ECE 558	Digital Imaging	
ECE 561	Detection & Estimation Theory	
ECE 564	Modern Light Microscopy	
ECE 569	Inverse Problems in Optics	
ECE 580	Optimiz by Vector Space Methds	

Total Hours 36

Other Requirements

Code	Title	Hours
	Minimum 500-level hours required overall:	12
	Minimum GPA:	3.0
	Minimum credit hours taken from the University of Illinois at Urbana-Champaign campus:	12
	Maximum number of previous University of Illinois at Urbana-Champaign graduate-level coursework not applied to any other degree that may be transferred and applied to the major pending department and Graduate College approval.	12

EP Documentation

Attach Rollback/Approval Notices

Correspondence with sponsor ep21040.pdf

DMI Documentation

Program Reviewer Comments

Deb Forgacs (dforgacs) (Mon, 03 Feb 2020 22:57:41 GMT):Rollback: request

Amy McCullough (amccul2) (Fri, 13 Mar 2020 18:48:41 GMT):Rollback: Rolling back to Department to make edits per the Subcommittee's recommendations.

Brooke Newell (bsnewell) (Tue, 17 Mar 2020 13:01:33 GMT):Rollback: Dept error in approving before changes made.

Deb Forgacs (dforgacs) (Thu, 19 Mar 2020 14:57:51 GMT):Rollback: request.

Keri Pipkins (kcp) (Fri, 15 May 2020 16:07:31 GMT):Rollback: Rolling back to correct course numbers.

Keri Pipkins (kcp) (Thu, 21 May 2020 20:34:54 GMT):Rollback: Please enter a valid CIP Code.

Key: 957

Biomedical Image Computing, MS

Academic Catalog Entry

Overview

department head: [Mark Anastasio](#)

director of graduate studies: [Gregory Underhill](#)

overview of admissions & requirements: <https://bioengineering.illinois.edu/admissions/graduate/>

overview of grad college admissions & requirements: <https://grad.illinois.edu/admissions/apply>

department website: <https://bioengineering.illinois.edu/>

program website: <https://bioengineering.illinois.edu/academics/graduate/ms/>

department faculty: <https://bioengineering.illinois.edu/directory/>

college website: <https://grainger.illinois.edu/>

E-mail: bioe-gradprograms@illinois.edu

address: 1240 Everitt Laboratory, 1406 W Green St, Urbana, IL 61801

phone: (217) 333-1867

The M.S. in Biomedical Image Computing blends together the fields of biomedical imaging science and machine learning. Students will receive a rigorous training in imaging systems and analysis, computational imaging, and machine learning, in preparation for an industry career.

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Biomedical Image Computing, MS

Academic Catalog Entry

Degree Requirements

Core Coursework		
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BIOE 485:	Computational Mathematics for Machine Learning and Imaging	4
BIOE 486:	Applied Deep Learning for Biomedical Imaging	4
BIOE 488:	Applied High-Performance Computing for Imaging Science	3
BIOE 489:	Regulations, Ethics and Logistics in Biomedical Applications of Machine Learning	4
BIOE 580:	Foundations of Imaging Science	4
BIOE 588:	Biomedical Image Computing Capstone Project Literature Review	1
BIOE 589	Biomedical Image Computing Capstone Project	4
Additional Courses:		4
BIOE 586	Deep Generative Models in Bioimaging OR	4
	Approved Elective Course (see below)	4
Approved Electives:		
BIOE 505	Computational Bioengineering	
BIOE 507	Advanced Bioinstrumentation	
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ECE 561	Detection & Estimation Theory	
ECE 564	Modern Light Microscopy	
ECE 569	Inverse Problems in Optics	
ECE 580	Optimiz by Vector Space Methds	
Total Hours		36

Other Requirements and Conditions(may overlap)

Minimum 500-level hours required overall:	12
Minimum GPA:	3.0
Minimum credit hours taken from the University of Illinois at Urbana-Champaign campus:	12
Maximum number of previous University of Illinois at Urbana-Champaign graduate-level coursework not applied to any other degree that may be transferred and applied to the major pending department and Graduate College approval:	12

January 31, 2020

To Whom It May Concern:

The Department of Electrical and Computer Engineering is aware of and supports the proposal for the creation of a new MS degree in Biomedical Image Computing, to be offered through the Department of Bioengineering. The relevant faculty in our department have been included in the process of developing the new degree program and have provided appropriate feedback.

We are supportive of listing the following courses as part of the approved electives for the program:

ECE 534: Random Processes
ECE 543: Statistical Learning Theory
ECE 544: Topics in Signal Processing
ECE 547: Topics in Image Processing
ECE 549: Computer Vision
ECE 558: Digital Imaging
ECE 561: Detection & Estimation Theory
ECE 564: Modern Light Microscopy
ECE 569: Inverse Problems in Optics
ECE 580: Optimization by Vector Space Methods

Sincerely,



Bruce Hajek
Leonard C. and Mary Lou Hoefft Endowed Chair and Head
Department of Electrical and Computer Engineering



GRADUATE COLLEGE

110 Coble Hall, MC-322
801 S. Wright St.
Champaign, IL 61820

PROGRAM TUITION WAIVER POLICY PROPOSAL

Proposals to establish or revise tuition waiver policy for a graduate program will follow a shared governance approval process (Department, School, College, Graduate College).

Definitions of Tuition Waiver Policy Designations:

Traditional Programs. Programs either designated as generating full or base-rate tuition waivers. Base rate waivers waives only the Resident Graduate Base tuition amount. Non-Residents or students in a program with an additional tuition differential will be responsible for the remaining portion of tuition.

Reimbursable Programs. Programs identified as programs that would be reimbursed from an appointing unit outside their academic college.

Cost-recovery and self-supporting programs. Students in approved cost-recovery and self-supporting programs are not eligible to receive tuition and fee waivers except statutory waivers. Students in these programs are not eligible to hold a waiver generating graduate appointment (Assistantship or Fellowship). Full time employees may be admitted to these programs, but their employee waiver is not eligible for use towards a program with this designation.

Additional information related to these tuition waiver designations can be found here:
<http://www.grad.illinois.edu/gradhandbook/2/chapter7/tuition-waivers#otherprovisions>.

PROGRAM INFORMATION

COLLEGE OR SCHOOL: Grainger College of Engineering

PROGRAM(s) (Include Program Codes if applicable): MS: Biomedical Image Computing

<p>REQUESTED DESIGNATION (Select desired designation type):</p> <p><input type="checkbox"/> Self-Supporting</p> <p>Comments:</p>

- 1) Describe the reasons for this request and explain: (a) the pros and cons of the classification requested, and (b) how the requested classification will benefit and not adversely affect the academic quality of the program.**

This is a request to establish a new self-supporting MS degree. This is not a research-oriented program. It is designed so that it can be completed in three semesters and will provide a relevant and rigorous technical training in biomedical imaging and machine learning. This training will make the graduates of the program highly sought after from industry and other research organizations.

The requested classification will not adversely affect the quality of the program in any way. The curriculum has been carefully designed to provide a high value to students. The courses will also be made available to certain advanced undergraduate and other graduate students in the Department of Bioengineering and Grainger College of Engineering, to be taken as electives in their degree programs. The new courses that have been developed are innovative and address topics of great interest to UIUC students. It is fully expected that the enrollments of the courses would be high, even if the MS degree did not exist.

- 2) Describe the expected impact of the requested classification to new students. How will these measures affect the affordability of the program? What type of financial aid, if any, will be offered? Note: Continuing students will not be affected as they are subject to the rules in effect at the time of their admission.**

This is a new program. All students entering program will need to pay tuition. No financial aid will be offered to students that involves state funds.

- 3) What provisions will be made to communicate the implications of the classification to prospective and newly admitted students?**

The self-supporting nature of the program will be clearly explained on the program's website and in any and all communications to prospective students.

- 4) Name the college and program contact persons in charge of implementing and communicating the classification and its consequences to students.**

Director of the MS Program in Biomedical Image Computing, TBD
Krista Smith, Graduate Programs Coordinator, Department of Bioengineering

The Grainger College of Engineering contacts for this program are Harry Dankowicz, Associate Dean for Graduate, Professional and Online Programs, and the Executive Director of Engineering Graduate Programs (TBD)

JUSTIFICATION: On a separate sheet, please address the following.

1. Describe the reasons for this request and explain: (a) the pros and cons of the classification requested, and (b) how the requested classification will benefit and not adversely affect the academic quality of the program.
2. What type of financial assistance will be offered to students in the program?
3. Has this program had past practice of offering graduate assistantships? If so, please describe.
4. What provisions will be made to communicate the new classification to prospective and newly admitted students?

APPROVALS: (May use Adobe Signature or print and sign the document)

Department Executive Officer Signature and Date: *Mike Anastos* 10-22-20

Disciplinary College Signature and Date: _____

Graduate College Signature and Date: *Harry Daulton* 12-11-20

↓
Allison McKinney 12/11/20





DEPARTMENT OF COMPUTER SCIENCE

Thomas M. Siebel Center for Computer Science
201 N. Goodwin Ave.
Urbana, IL 61801-2302 USA

NANCY M. AMATO

Abel Bliss Professor and Head
2248 Siebel Center
namato@illinois.edu

January 31, 2020

To Whom It May Concern:

The Department of Computer Science is aware of and supports the proposal for the creation of a new MS degree in Biomedical Image Computing, to be offered through the Department of Bioengineering. The relevant faculty in our department have been included in the process of developing the new degree program and have provided appropriate feedback.

We are supportive of listing the following courses as part of the approved electives for the program:

CS 543: Computer Vision
CS 547: Deep Learning

Sincerely,

A handwritten signature in black ink that reads 'Nancy Amato' in a cursive script.

Nancy M. Amato
Abel Bliss Professor and Head
Department of Computer Science

From: [Pahre, Jennifer N](#)
To: [Anastasio, Mark A](#)
Cc: [Lehman, Barbara J](#); [Martensen, Kathy](#)
Subject: Re: Senate Ed Policy Proposal -- Question about Biomedical Image Computing MS
Date: Wednesday, January 20, 2021 3:38:24 PM
Attachments: [Outlook-4zqo3dqe.png](#)

Dear Mark,

Thank you for your very prompt reply. This information is helpful, and answers well the pending question.

I will reach out if there any further questions. For now, however, I think we're all set.

All best,
Jennie

I ILLINOIS

College of Law

Jennifer N. Pahre

Director of Undergraduate Studies

Assistant Teaching Professor

University of Illinois College of Law

504 East Pennsylvania Avenue

Champaign, Illinois 61820

Pronouns: She/her/hers

Under the Illinois Freedom of Information Act (FOIA), any written communication to or from University employees regarding University business is a public record and may be subject to public disclosure.

From: Anastasio, Mark A <maa@illinois.edu>

Sent: Wednesday, January 20, 2021 3:07 PM

To: Pahre, Jennifer N <jpahre@illinois.edu>

Cc: Lehman, Barbara J <bjlehman@illinois.edu>; Martensen, Kathy <kmartens@illinois.edu>

Subject: Re: Senate Ed Policy Proposal -- Question about Biomedical Image Computing MS

Dear Jennie,

Thank you for the email and we sincerely appreciate the efforts of the committee to review our proposal.

To answer the question: It is indeed true that the program will initially contain only one elective. We are aware that this may be a bit atypical. The reason for having only one elective is a practical and not an ideological one. Specifically, the other required courses are simply considered to be "mission critical" in terms of delivering the specialized training at the

interface of modern imaging science and machine learning that we seek. In fact, we believe this is what will make the new degree special and will render it highly valued by both students and employers.

Having said that, we will closely monitor the new program and quantitatively assess it. If feedback from students and employers suggests that additional program flexibility is warranted, we will certainly adapt accordingly.

I'll be happy to provide additional information as needed.

Thanks,
Mark

MARK ANASTASIO

Donald Biggar Willett Professor in Engineering
Head, Department of Bioengineering
Affiliate Professor, Department of Computer Science
Affiliate Professor, Department of Electrical and Computer Engineering
Affiliate Professor, Carle Illinois College of Medicine
Member, Beckman Institute for Advanced Science and Technology

Department of Bioengineering | The Grainger College of Engineering
1406 W. Green Street | 1102G Everitt Lab, MC 278 | Urbana, IL 61801
(P) 217.300.0314 | maa@illinois.edu
<https://bioengineering.illinois.edu/>
Lab Website: <https://anastasio.bioengineering.illinois.edu>

On Jan 20, 2021, at 2:51 PM, Pahre, Jennifer N <jpahre@illinois.edu> wrote:

Dear Professor Anastasio,

I hope that your week is going well, and that you and your family remain healthy.

I'm the chair of subcommittee A of the Senate Educational Policy Committee. Your proposal for a new Master of Science in Biomedical Image Computing (EP 21.040) has come to my subcommittee for review.

My subcommittee thinks that the new program looks excellent. We recognize that biomedical image computing is an important and rapidly growing industry and research field, and I and the members of my subcommittee are firmly in favor of the new MS.

One member of my subcommittee had a late-breaking question, and thus I am reaching out, as you are listed as the proposal's formal sponsor. (If there is someone else I should address, please let me know.) Our next Ed Pol meeting is this coming Monday, January 25. I am not sure if it will be possible to clear up this question before then, but I'd like to try so that I can present your proposal with all subcommittee questions answered to facilitate its swift approval.

The question concerns just one issue, the number of elective courses. It seems that there is just one elective course offered as part of the program. (*I wonder if you and your colleagues anticipate adding more electives in the future, after the program has been launched?*)

I look forward to hearing from you.

With thanks,

Jennie

Jennifer N. Pahre
Director of Undergraduate Studies
Assistant Teaching Professor
University of Illinois College of Law

<Outlook-yitj2m4z.png>

Jennifer N. Pahre
Director of Undergraduate Studies
Assistant Teaching Professor
University of Illinois College of Law
504 East Pennsylvania Avenue
Champaign, Illinois 61820

Pronouns: She/her/hers

Under the Illinois Freedom of Information Act (FOIA), any written communication to or from University employees regarding University business is a public record and may be subject to public disclosure.