proposal: CENTER FOR COMPUTER RESEARCH IN MUSIC AND ACOUSTICS

from: Leland C. Smith and John M. Chowning

The Departments of Music and Computer Science, ten years ago, began their support of computer music at a time when many universities considered such work to be anti-humanistic and/or trivial. At the time it was an open question as to the contribution technology could make to music; however, we believed that the audio-loudspeaker was indeed the "instrument" of the future and that the most promising method of control was by means of computers.

The desire of the composer to expand and control his material is unbounded and it was such a quest which led to the development of electronic music following WW II. Studios in Europe and America have proliferated as analog synthesizers have become ever more sophisticated. The deficiency of analog synthesis, however, is that it is not sufficiently general to allow the composer to control his material from the elemental level of the sound itself to the higher levels of form. The hybrid system, a computer controled synthesizer, is a solution to the control on a formal level, but it will not allow the composer to "get his hands on" the structure of the sound itself. Digital synthesis techniques are now seen to be the general solution for the composition of electronic music - at least they can theoretically produce any perceivable sound. The remaining difficulty is that very little is known about sound that is of sufficient complexity (interest) to be useful to composers: which is to say, sound no less complex than that of musical instruments. Composers are doing research in acoustics and psychoacoustics because it is critical to the development of the art, but the problems are complex and will only be solved through inter-disciplinary research.

Stanford was the first to develop a self-contained, interactive system for direct digital synthesis using computers supported by powerful synthesis and composition programs. There are two particularly visible indicators which affirm both the initial foresight of the Department of Music and our success at achieving what we set out to do; first, we have been supplying in recent years a growing number of universities with our programs and special knowledge (including Columbia, Princeton, Carnegie-Mellon, Michigan State, and Colgate); second, we have been asked by Pierre Boulez, composer-conductor and a major international figure, to participate in the planning for, and research within, the Institute de Recherche et de Coordination Acoustique/Musique which is being built as part of the Centre Beaubourg in Paris and which Boulez will direct beginning in 1975. It is significant that in the plans for this institute and in an increasing number of universities, the primary research tools for acoustics and composition are computers rather than analog synthesizers.

At the Stanford Artificial Intelligence Laboratory we have developed programs and techniques for the simulation of moving sound sources in reverberant spaces, the composition of music, the editing of manuscripts, and the analysis and synthesis of complex signals, some of which are startlingly simple in their implementation and novel in conception. While the progress of this research has certainly been enhanced by the high level of technological expertise at the A.I. Lab., it has been equally dependent upon the cross-disciplinary skills of the researchers themselves. It is this inter-disciplinary aspect which has given our research its particular character and which circumscribes our interests.

We have certainly benefited from our association with the A.I. Lab.; however, we are a burden to the computer system. It is clear that in order to continue our work on a substantive basis we must become, to some extent, independent. Independence requires support which requires an idea - therefore, this proposal.

ORGANIZATION

We propose that the Department of Music continue the work with computers by organizing a center for research in acoustics and music, contingent upon our success at finding support outside of the university. For the following reasons the center would have a logical existence at Stanford:

1. Our work in this area is already well-established and highly regarded,
2. We have the research momentum and a staff which reflects the inter-disciplinary nature of the research,
3. Stanford's balance between the technological and the humanistic disciplines would provide an ideal nutrient environment for such a center.

The center should be organized in such a way that it has a direct relationship to the academic program of the department, but should be to some degree automonous in determining its research projects and staff.

ACADEMIC CONTRIBUTION

teaching

Since 1966 the department has included in its curriculum the 220 series, computer sound synthesis and composition. These courses have been necessarily small because of the limited computer time available to the students. The center could provide the facilities and teaching staff for expanding this program into a number of courses and seminars for both the general student and the graduate student who has a special interest in acoustics and electronic music. Within the competence of the proposed staff are the following courses and seminars.

General Courses-
- Musical Acoustics
- Psychoacoustics
- Electronic music (repertory and analysis)

Specialized Courses and Seminars-
- Digital sound synthesis
- Composing programs and algorithms
- Digital Processing and pertinent mathematics

research

In addition to the research projects of the staff, the center should support research projects of specially interested graduate and undergraduate students from the university at large. It has not been unusual in the past, for students from other departments, e.g. computer science, psychology, engineering, to make significant contributions in the field and this interaction should surely be encouraged.

composition

One of the very real difficulties in the past has been the acquisition of sufficient computer time to compose works of large proportions. Here, the new technology can certainly help us. As noted below (Budget), a special purpose processor can generate in real-time, complex musical works which take tens of hours of computation on the current PDP-10 system. The center would be an open facility for composers in the Department of Music.

We would propose a program where major guest composers are invited to work at the center for specific periods of time. This program would not only aid the dissemination of our research results to the outside, but would contribute to the general level of artistic activity on campus in the form of concerts and lectures. For example, Gyorgy Ligeti, a well-known European composer, has expressed interest in working at Stanford.

STAFF

Leland C. Smith, Professor of Music, Faculty advisor

1.	John M. Chowning	music composition
2.	Loren Rush	music composition
3.	John M. Grey	psychology
4.	James A. Moorer	computer science

LOCATION

There are advantages in maintaining our association with the A.I. Lab.

1. There is no requirement for additional space
2. We can buy a 'piece' of a hardware engineer's time
3. Our system can be an 'invisible peripheral' to the PDP-10 system
4. We have available to our system the PDP-10 software
5. We benefit from the high level of technological expertise and insights - ideas breed ideas

We have discussed this matter with John McCarthy and he has agreed in principle to our continued association, subject to the condition that we pay in proportion to our use of the system. Any proposals for support which we submit, therefore, must first be perused and approved by him.

EQUIPMENT

The department now owns some excellent audio equipment which is kept at the A.I. Lab. Most of this was bought from the license income of the spatial processing invention.

1.	4-channel Scully recorder	value	$4,000.
2.	4-channel Sony recorder		1,300.
3.	4-channel Dolby noise suppressor		2,400.
4.	4-channel amplifier speaker system		1,000.
5.	1/2 and 1/4 in. audio tape supply		500.
6.	reserve for equipment repair etc.		1,000.
	Total		$10,200.

BUDGET - less indirect costs

The budget presented here is what we consider to be a workable minimum. Additional equipment, (e.g. an acoustic-isolation module, larger computer system) and part-time staff, (e.g. programmer and graduate student support) would be desirable.

There are two additional pieces of equipment we need in order to become invisible to the PDP-10 system.

One-time costs		
1. PDP-11 45 mini-computer		$45,000.
2. Special purpose acoustical processor		c. 20,000.
3. Interface to the PDP-10		5,000.
	Total	ca $70,000.
Per year costs		
1. Disk rental (file storage)		8,500.
2. Mag tape and audio tape		500.
3. Equipment maintainence		1,000.
4. 1/4 system engineer		2,500.
5. 1/5 secretarial help		1,800.
6. 4 staff salaries		ca 52,000.
	Total/year	ca $66,000.

In order to continue our research and buy the above capital equipment we are preparing a proposal for NSF to cover the costs for a two-year period. We would approach foundations as well, given the university's approval. M.V. Mathews, Director of the Behavioral Research and Acoustics Laboratory, Bell Telephone Laboratories, has offered his help in finding support for the research and/or the center.