

Distributed Acoustic Sensing Community Resources

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Distributed Acoustic Sensing (DAS) is a technology being applied to a wide range of fields, using fiber optics to observe ground motion, monitor wells and infrastructure, track human and animal activity, and more. The DAS Research Coordination Network (RCN) was proposed and funded by the National Science Foundation to support the development of the DAS community as well as DAS Community Resources. The DAS community is growing, as is access to the technology, however ensuring equitable access will require the availability of community infrastructure: lending libraries of interrogators and splicing kits, low to no cost training for fiber installation as well as access to expertise, and support for data archival, analysis, and distribution.

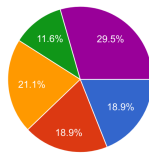
To better understand what resources are already available and to identify community needs, an anonymous, 10 question survey was launched and distributed widely through the DAS mailing list managed by IRIS and the DAS RCN steering committee and working groups, with further distribution encouraged especially to reach specific research disciplines. Results were presented and discussed on an open invitation 1-hour Zoom call with community members.

Survey and Results

The survey was responded to by 95 DAS community members, with a balanced distribution of experience, about one third novice, one third intermediate, and one third expert, Figure 1a. The distribution of career stages was similarly balanced, Figure 1b, distributed evenly from student, recent graduates or post docs, early career (within 10 years since receiving terminal degree), middle career (within 20 years since receiving terminal degree), and established (20+ years since receiving terminal degree). Current location of respondents was evenly split between North America and Europe, with only 8 respondents reporting from Oceania, South America, Central America, and Asia. Of research areas, Seismology was the most represented by far, Figure 1d.

a)

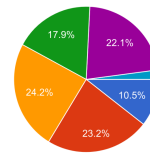
What is your background with DAS?
95 responses



- 1 (not much beyond knowing what DAS stands for)
- 2
- 3 (have computed on DAS data before)
- 4
- 5 (have published a paper that used DAS data)

b)

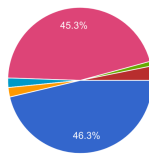
What career stage are you?
95 responses



- Student (currently enrolled in an institution)
- Recent graduate or post doc (within five years of receiving your highest terminal degree)
- Early career (within 10 years of receiving your highest terminal degree)
- Middle career (within 20 years of receiving your highest terminal degree)
- Established/Senior (>20 years from re...)
- Do not wish to answer

c)

What is your current location by region?
95 responses



- North America
- Central America
- South America
- Caribbean
- Africa
- Middle East
- Europe
- Asia
- Oceania

d)

How would you categorize your primary research area(s)? Choose as many as apply.
95 responses

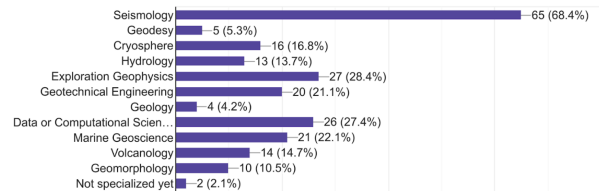


Figure 1. a) Responses for “What is your background with DAS?” b) Responses for “What career stage are you?” c) Responses for “What is your current location by region?” d) Responses for “How would you categorize your primary research area(s)? Choose as many as apply.” Not shown are 12 additional respondents with specific research areas.

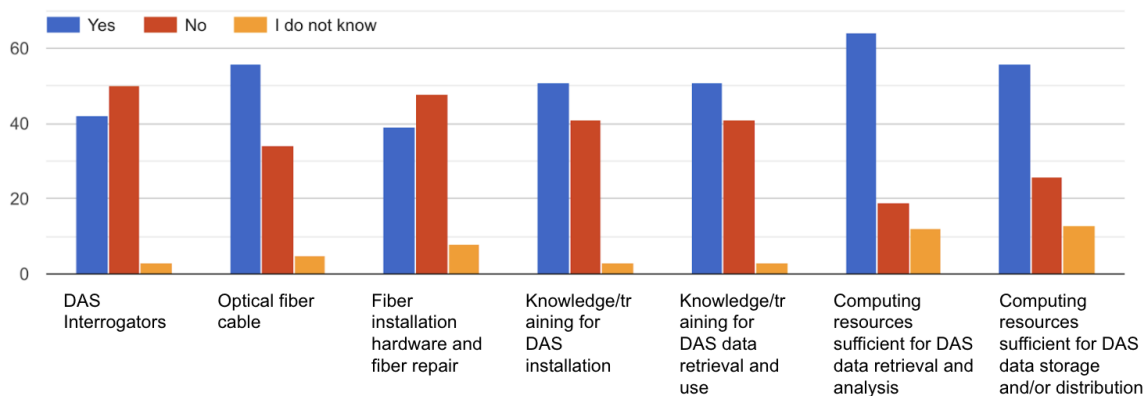
The area of greatest need identified was for instrumentation (interrogators, fiber) as well as training for the handling and installation of that instrumentation, Figure 2. Interrogators were a greater need, which is not surprising due to the high cost of such instrumentation (usually around \$100k).

Access to computational resources for data analysis, data storage, and data distribution appeared to be much higher than instrumentation. However, a larger portion of respondents answered “I don’t know” to these questions on data resources so the question may have been confusing or misleading. The answers may also have been skewed by new DAS users, or by the prevalence of seismologists.

Overall, about half of respondents indicated they needed one or more DAS resources (instrumentation, training, data handling), whereas half of respondents appear to have what they need.

a)

Do you have “ready” access in your laboratory/research group/university to the following? Check all that apply.
(DAS Interrogators)



b)

What tools or resources do you think you would need, that you don't currently have, to carry out a successful DAS deployment/research project? Check all that apply.

95 responses



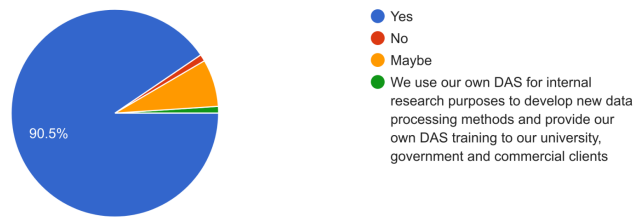
Figure 2. a) Responses for “Do you have ‘ready’ access in your laboratory/research group/university to the following? Check all that apply.” b) Responses to “What tools or resources do you think you would need, that you don't currently have, to carry out a successful DAS deployment/resource project? Check all that apply.” Not shown are additional respondents specifying fiber splicing equipment, pre(processing) software/code, support for knowledge sharing, data storage, calibration strategies. One respondent noted they currently have all resources needed.

To understand the urgency of these needs in the community, questions were also asked about if and when community resources would be used. Most (90%) indicated they would be interested in using DAS in their research or teaching in the next 5 years, Figure 3a. If DAS instrumentation

were available as a lending library along with training in the model of IRIS PASSCAL and CTEMPs, about 75% of respondents would use those resources at least once in the next 5 years, with more than half indicating they would use it at least once a year, and 25% indicating continuous use of such a resource, Figure 3b. This is interesting as about half of respondents indicated they had what they needed for DAS, but that they would still plan to use a community resource in addition to their own.

a)

If DAS systems were available to you, do you envision using DAS in your research or teaching in the next 5 years?
95 responses



b)

If DAS instrumentation and training were offered as a community resource following the "lending library" models of IRIS PASSCAL and CTEMPs, how often would you envision using these resources?
95 responses

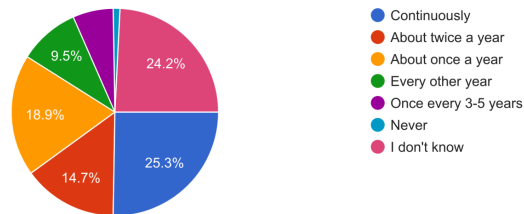


Figure 3. a) Responses to "If DAS systems were available to you, do you envision using DAS in your research or teaching in the next 5 years?" b) Responses to "If DAS instrumentation and training were offered as a community resource following the "lending library" model of IRIS PASSCAL and CTEMPs, how often would you envision using these resources?"

Discussion and Recommendations

The survey reached a representative sample (95 respondents) of the DAS RCN community; the DAS mailing list managed by IRIS is the most definitive estimate with a membership of 468 subscribers. DAS instrumentation, training, and data resources are available to about half of

these respondents. However even among those who have access, there was still interest in using the community resources on top of their own if it was available. Additionally, even if there was a smaller percentage of respondents who do not have access to DAS resources, it would remain a top priority of the RCN to advocate for the democratization of access to instrumentation, training, and data to all users and potential users of DAS.

Training in installation of fiber and opportunities for hands-on experience with instrumentation is needed to strengthen the DAS community. There are good examples of the effective introduction of new technology to a community, such as the training work of CTEMPs in DTS and the Oklahoma Wavefields seismic node experiment run by IRIS.

Fields like seismology are heavily represented in the DAS RCN. Responses about access to instrumental and computation resources may be impacted by this. Future work on the survey will include drilling down by discipline on the responses. Efforts to reach out to geotechnical, mining, communications, and other industries will continue at the RCN, as well as continuing support for small but growing communities like Geomorphology that may have less access to instrumentation due to a smaller user base.

It is generally understood in the community that data and metadata are significant problems to tackle for DAS in the near term, particularly to enable data distribution between institutions and across fields. This daunting task may not be as visible to all community members, particularly those new to DAS. Future work on the survey will include analysis by user familiarity with DAS. However, some respondents took the open comment section at the end of the survey to emphasize the importance of developing a standard data and metadata format for DAS as well as supporting data handling, management, and distribution. This will be important for meeting the publication requirements for data storage as well as encouraging additional users of data sets by preserving raw data with full frequency range. Training is desired for data in addition to the training for instrumentation; this training should cover data handling, methodologies, strategies, preprocessing, and calibration of data sets. These aspects of data handling cannot be fully removed from the instrumentation itself.

In the near term, it is recommended that a list of DAS interrogators be compiled and maintained. This may not be comprehensive or a fully democratized system, but it will provide information similar to the first stage of the seismic Node Owner Group (NOG) initiated by IRIS. If a community instrumentation and training model is pursued, the future facility would benefit from coordinating with instrument vendors. Additionally, collaborating with existing organizations like SPIN-ITN in addition to IRIS and CTEMPs, if not already managing the effort.

Volunteers from the respondent pool were asked to provide valuable feedback on this white paper; the DAS community will continue to be engaged as community resources are planned, proposed, and developed. If you are interested in being part of this ongoing discussion, please get in touch with das-rcn@iris.edu.

Table 1. Example of Table for DAS equipment available for lending.

Name	Email	Equipment