Space-Point Web Services:
A new, efficient tool for finding the right space systems components

R. Fleeter[(1)], G. Colonna[(2)], M. Menapace[(3)], E. Stefanini[(4)], M. Stipa[(5)]

[(1)] Space-Point
Via Dei Fulvi 47 00174 Rome, (RM) Italy
rick.fleeter@space-point.com

[(2)]Space-Point
Via Dei Fulvi 47 00174 Rome, (RM) Italy
giuseppe.colonna@space-point.com

[(3)]Space-Point
Via Dei Fulvi 47 00174 Rome, (RM) Italy
marco.menapace@space-point.com

[(4)]Space-Point
Via Dei Fulvi 47 00174 Rome, (RM) Italy
enrico.stefanini@space-point.com

[(5)]Space-Point
Via Dei Fulvi 47 00174 Rome, (RM) Italy
mattia.stipa@space-point.com

INTRODUCTION

A fundamental part of space systems design, both in proposal preparation and in early program phases, is component selection, without which a realistic estimate of system performance and budgets for mass, power and cost, is impossible. The reliability of these estimates is critical for system engineering, program planning and competitive valuation. However the reality of space systems detailed design and development often includes a futile, resource-consuming search for often non-existent components matching the specifications of the ideals contained in the proposed design. Imposing upon the design the constraints of components actually available, taking into account requirements for qualification, heritage, margins, export, country of origin purchase constraints, mass and dimensional constraints, inevitably changes both the design and its capabilities. Ultimately the system is redesigned based on obtainable components, at the expense of budget, schedule and achieved performance.
Component suppliers face the same issues from their side of the transaction. Traditional search engines are not designed to find, for example, magnetic torque coils nor space

qualified switches and sensors. Thus the supplier encounters difficulty achieving visibility to the customer amidst the clutter of the internet, a problem particularly acute for passive components which are so widely produced for use in applications other than space.

Having confronted the problems of finding and of being found in our own work and those of our teams and students, thus understanding the importance of the problem and having ourselves developed some efficient and accurate methods to vector to desired components, we jointly founded Space-Point.com, a group dedicated to making the link between space systems designers and suppliers, mainly through the creation of a comprehensive, searchable component knowledge management system available via the internet using a friendly and simple user interface.

In achieving this straightforward goal, we learned that to create and maintain a large global database of components and their suppliers, numerous obstacles have to be overcome.

Over the past three years, Space-Point has meet these challenges and now offers a database of about 10,000 space component suppliers and about 4000 discreet components (not counting various versions of each component type). Searches are first narrowed by subsystem, for example attitude control or communications. Then there are numerous filters available, for instance to search only for components from vendors a within or outside a certain region, or by mass. All searches can be narrowed to find only passive components, which are present within every spacecraft subsystem dataset including attitude control, communications and thermal system and include couplers, detectors, magnetics, relays and switches, heaters and thermal sensors. Each component found is presented with the vendor contact data and all relevant technical details.

The population of space systems components is vast and constantly growing and changing requiring us to constantly check and update the database. This maintenance requires continued investment but is key to the system's of accuracy and reliability.

The database includes links to manufacturer's sites and component datasheets which also change and expire over time, but which are critical to obtain the highest level of component definition. Thus our goal has been not only to list the components, but wherever possible provide contact coordinates for obtaining more information. This feature offers to each component supplier an opportunity for increased visibility within its customer population.

Each family of components (for instance, a hinge or a passive sun sensor) is described by its own set of design parameters through which the designer may desire to narrow the search, requiring that the database be in fact an ensemble of a number of diverse databases all searchable through a single, simple user interface. For each category of component, the user can narrow the search per its particular performance requirements, country of origin, or level of space qualification.

When we first assessed the state of the art of component databases, we realized that no extensive, detailed, regularly updated, publicly available, searchable database of space components existed, though suppliers, designers, faculty and students repeatedly told us how useful such a database would be. Without it designers spend much of their time in often fruitless searches for the basic building blocks of their designs. The difficulties of finding components suited to myriad technical and programmatic requirements slows team

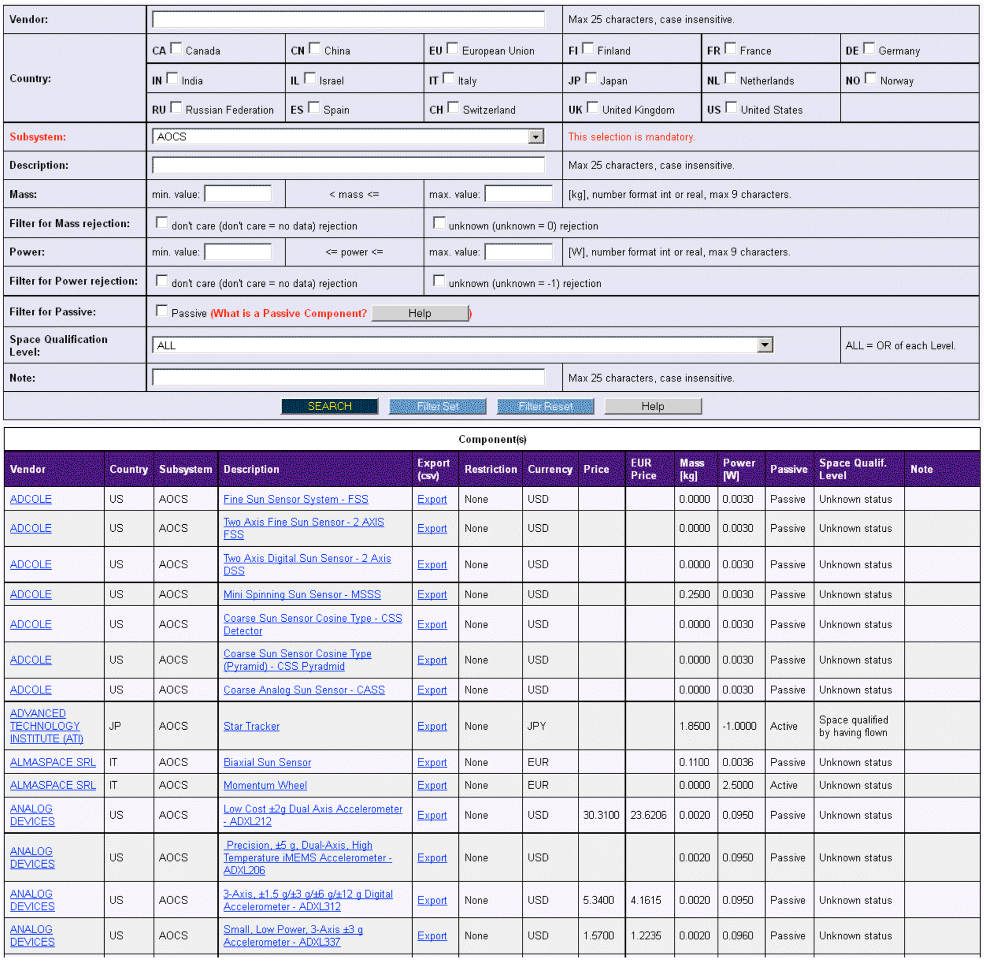
progress, particularly in the early phases (0, A and B) of a project. These delays are particularly important in commercial competition and then manifest in changes and overruns in the programs after contract award - when reality sets in!
The development of a fast, comprehensive, searchable, economic, publicly available, regularly updated database of components, accessible via a web browser or via web services directly integrated within Concurrent Engineering facilities, is an important tool for designers as well as a new means for suppliers to help their products find application in real missions with a minimum investment of time and money and maximum design fidelity.

THE SYSTEM

The operational Space-Point Knowledge Management System (KMS) [3] organizes the satellite component data on the basis of high level properties (mass, power, technology readiness level) shared by all the constituent components, and then at a more detailed level on the bases of properties specific to each sub system category of the components (for example for radio transmitters their RF band and power output).
The KMS was designed at the conceptual level keeping the principles described in reference [4] in mind; and it is now fully operational in versions accessed via web Browser and via Concurrent Engineering Facilities (CEF) via Web Services, providing comprehensive component data for the systems designer.
The Passive Components symposium has provided us the opportunity to extend the information provided by our KMS, associating the attribute of "passive component" to all suitable components already present in the database that underlies the KMS. Since every component is either passive or active, filtering for one or the other is provided at the high level search. We have used the definition of passive provided in connection with the ESA Passive Component Days symposium.
The ability to narrow searches to active or passive components has effected every aspect of the KMS's operation, the queries, the software controlling the searches, the user interface and the operation of the Web Services. But the KMS is composed of low-coupled modules, a rigorously Object-Oriented architecture, based upon the principles of Object Oriented Analysis, Design and Programming (OO AD&P), and of the Unified Modelling Language (UML). From the point of view of the software engineering, the upgrade of the site to accommodate searches for passive / active attributes has not required a major restructuring effort.
In this sense, this symposium has put to the test our underlying software engineering architectural strategy and attention to quality engineering. The early integration of these concepts into the KMS have proven their effectiveness with the ease in which the new search capabilities were added to the service. We also noted that the performance of the system has not been reduced despite the addition of the new functionality [3].
Besides the software engineering impact of the passive /active search feature, each component in the database had to be associated with one of the two categories. This upgrading took advantage of our automatic, off-line procedure for updating the database,

based on data supplied by our research team, which has thus had the opportunity to prove itself efficient and reliable. This capability is critical since the database is designed to be updated frequently as components, their specifications, and associated data and links, change over time. These updates need to be carried out without interrupting the continuity of service to our clients.

From the users perspective, the passive /active filter is now available to narrow searches and selection of components. If the user does not active the checkbox labeled "Passive" the filter is not activated allowing the visualization of both passive and non-passive components.



Vendor: Max 25 characters, case insensitive.

Country: CA Canada | CN China | EU European Union | FI Finland | FR France | DE Germany | IN India | IL Israel | IT Italy | JP Japan | NL Netherlands | NO Norway | RU Russian Federation | ES Spain | CH Switzerland | UK United Kingdom | US United States

Subsystem: AOCS — This selection is mandatory.

Description: Max 25 characters, case insensitive.

Mass: min. value: < mass <= max. value: [kg], number format int or real, max 9 characters.

Filter for Mass rejection: don't care (don't care = no data) rejection — unknown (unknown = 0) rejection

Power: min. value: <= power <= max. value: [W], number format int or real, max 9 characters.

Filter for Power rejection: don't care (don't care = no data) rejection — unknown (unknown = -1) rejection

Filter for Passive: Passive (What is a Passive Component? Help)

Space Qualification Level: ALL — ALL = OR of each Level.

Note: Max 25 characters, case insensitive.

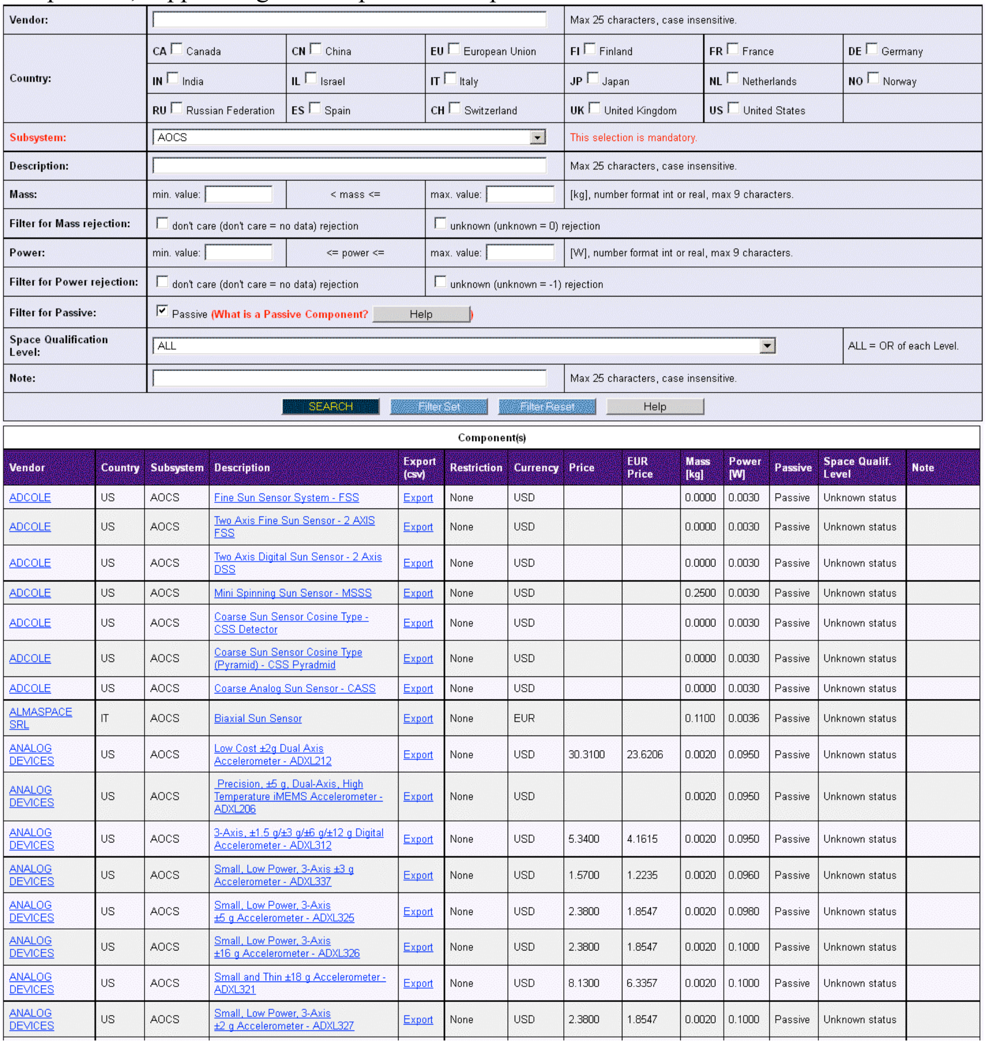
SEARCH | Filter Set | Filter Reset | Help

Component(s)

Vendor	Country	Subsystem	Description	Export (csv)	Restriction	Currency	Price	EUR Price	Mass [kg]	Power [W]	Passive	Space Qualif. Level	Note
ADCOLE	US	AOCS	Fine Sun Sensor System - FSS	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Two Axis Fine Sun Sensor - 2 AXIS FSS	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Two Axis Digital Sun Sensor - 2 Axis DSS	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Mini Spinning Sun Sensor - MSSS	Export	None	USD			0.2500	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Coarse Sun Sensor Cosine Type - CSS Detector	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Coarse Sun Sensor Cosine Type (Pyramid) - CSS Pyradmid	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Coarse Analog Sun Sensor - CASS	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADVANCED TECHNOLOGY INSTITUTE (ATI)	JP	AOCS	Star Tracker	Export	None	JPY			1.8500	-1.0000	Active	Space qualified by having flown	
ALMASPACE SRL	IT	AOCS	Biaxial Sun Sensor	Export	None	EUR			0.1100	0.0036	Passive	Unknown status	
ALMASPACE SRL	IT	AOCS	Momentum Wheel	Export	None	EUR			0.0000	2.5000	Active	Unknown status	
ANALOG DEVICES	US	AOCS	Low Cost ±2g Dual Axis Accelerometer - ADXL212	Export	None	USD	30.3100	23.6206	0.0020	0.0950	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Precision, ±5 g, Dual-Axis, High Temperature iMEMS Accelerometer - ADXL206	Export	None	USD			0.0020	0.0950	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	3-Axis, ±1.5 g/±3 g/±6 g/±12 g Digital Accelerometer - ADXL312	Export	None	USD	5.3400	4.1615	0.0020	0.0950	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Small, Low Power, 3-Axis ±3 g Accelerometer - ADXL337	Export	None	USD	1.5700	1.2235	0.0020	0.0960	Passive	Unknown status	

Fig. 1. Browser with the passive /active filter inactive

If the Passive checkbox is activated, the system allows visualization only of passive components, suppressing all non-passive component results.



Vendor	Country	Subsystem	Description	Export (csv)	Restriction	Currency	Price	EUR Price	Mass [kg]	Power [W]	Passive	Space Qualif. Level	Note
ADCOLE	US	AOCS	Fine Sun Sensor System - FSS	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Two Axis Fine Sun Sensor - 2 AXIS FSS	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Two Axis Digital Sun Sensor - 2 Axis DSS	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Mini Spinning Sun Sensor - MSSS	Export	None	USD			0.2500	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Coarse Sun Sensor Cosine Type - CSS Detector	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Coarse Sun Sensor Cosine Type (Pyramid) - CSS Pyradmid	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ADCOLE	US	AOCS	Coarse Analog Sun Sensor - CASS	Export	None	USD			0.0000	0.0030	Passive	Unknown status	
ALMASPACE SRL	IT	AOCS	Biaxial Sun Sensor	Export	None	EUR			0.1100	0.0036	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Low Cost ±2g Dual Axis Accelerometer - ADXL212	Export	None	USD	30.3100	23.6206	0.0020	0.0950	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Precision, ±5 g, Dual-Axis, High Temperature iMEMS Accelerometer - ADXL206	Export	None	USD			0.0020	0.0950	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	3-Axis, ±1.5 g/±3 g/±6 g/±12 g Digital Accelerometer - ADXL312	Export	None	USD	5.3400	4.1615	0.0020	0.0950	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Small, Low Power, 3-Axis ±3 g Accelerometer - ADXL337	Export	None	USD	1.5700	1.2235	0.0020	0.0960	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Small, Low Power, 3-Axis ±5 g Accelerometer - ADXL325	Export	None	USD	2.3800	1.8547	0.0020	0.0980	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Small, Low Power, 3-Axis ±16 g Accelerometer - ADXL326	Export	None	USD	2.3800	1.8547	0.0020	0.1000	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Small and Thin ±18 g Accelerometer - ADXL321	Export	None	USD	8.1300	6.3357	0.0020	0.1000	Passive	Unknown status	
ANALOG DEVICES	US	AOCS	Small, Low Power, 3-Axis ±2 g Accelerometer - ADXL327	Export	None	USD	2.3800	1.8547	0.0020	0.1000	Passive	Unknown status	

Fig. 2. Browser with the filter active

As the definition of passive components agreed for this symposium is not familiar to every designer, we provide a link to the formal definition and also a link to the symposium itself, a useful addition to the Help available to the researcher. All of these upgrades are also present in the version provided for Concurrent Engineering via Web Services.

REFERENCES

[1] Design Patterns - Elements of Reusable Object-Oriented Software, E. Gamma, R. Helm, R. Johnson, J. Vissides. Addison Wesley, 1994.

[2] PHP Manual, AAVV. P. Olson - the PHP Documentation Group, 2012-01-26.

[3] R. Fleeter, G. Colonna, M. Menapace, E. Stefanini, M. Stipa. Injecting reality into concurrent system engineering. 5th International Workshop on Systems & Concurrent Engineering for Space Applications SECESA 2012, ESA. Lisbon, Portugal, October 2012.

[4] Kant e l'ornitorinco. Umberto Eco, Bompiani, 1997.