A Rapid Global Access System for High Throughput Automation

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Introduction

The SpaceLab is a new vertically integrated platform developed to meet the continuing needs of laboratory automation. The Spacelab uses vertical space for the placement of instruments and labware and therefore optimizes the use of valuable laboratory floor and bench space. The system uses a precision gantry robot to rapidly move labware, and features a dual gripper design to help achieve high throughput.

Spacelab also features a modular design that allows the user to change the instruments and quickly set up the system for a different application.

The entire system environment can be controlled, making the Spacelab ideal for cell-based processes and assays as well as for enzyme-based assays, compound library sample management, or large-scale plate processing.

The System

The Spacelab uses vertical space for the placement of instruments and labware and therefore optimizes the use of valuable laboratory floor and bench space. Adjustable shelves allow instruments to be placed in a vertical array, minimizing floor space. The heart of the machine is a four-axis Cartesian robot offering very high throughput and excellent repeatability.

Spacelab features a dual gripper design to help achieve high throughput. With this design, one gripper is used to carry a plate to a location, and then the other gripper is used to remove the plate that is currently in that position. The accessed instrument can then be immediately started without having to wait for the robot to return the used plate to a stack or its next position.

Adjustable shelves allow instruments to be placed in a vertical array, minimizing floor space. The Spacelab can accommodate any available microplate-based laboratory automation instrument, proving maximum flexibility for assay development. The adjustable shelving system and programmability of the robot allow reconfiguration of the system to accommodate changing automation requirements.

The carousel stack system provides dense storage for all types of SBS-footprint labware, including shallow-well microplates, deepwell microplates, and tip racks. The stacks are removable for easy transport to and from loading stations or offline incubators, and simple manual advance button makes it easy for the operator to load the stacks into the system.

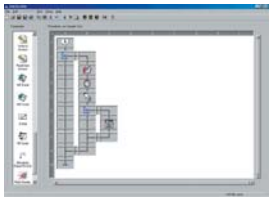
The system can be fully contained and have controlled environment such as HEPA filtration, nitrogen environment, temperature control, or even Class-II type control for protection of the operator and the contents. A built-in monitoring system ensures operator safety.

Software

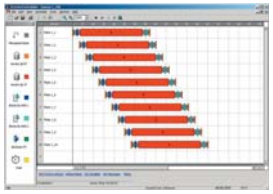
The Spacelab is controlled and scheduled by OVERLORD™ software from PAA. OVERLORD is a popular concept in supervisory software that allows the control of multiple instrumentation from one PC. OVERLORD operates in Windows 2000/XP environments with an easy to use drag and drop interface. OVERLORD utilizes the native software of ancillary equipment for maximum flexibility. Even the most complex system is easy to program and the most complex instrumentation is easy to integrate. The Overlord software for lab automation has an available driver set for more than 200 instruments on the market, meaning the user can select the individual components that work the best for their required assay and not be tied to a single vendor.

OVERLORD offers advanced scheduling capability and can be configured as an event-drive round robin scheduler or as a pre-emptive scheduling system that allows the creation of time-critical assays.

EVENT DRIVEN CONTROL is used when decisions need to be made during the run, or when there are regular errors that must be dealt with. Event-driven (also referred to as real-time, round robin, active, or dynamic) scheduling is provided with OVERLORD. The graphical representation to the user is a flow chart with decision points.



TIME DRIVEN CONTROL is used when the time reproducibility of the samples is critical or when there are multiple time-critical stages in the procedure. Time-driven (also referred to as pre-emptive or rigid) scheduling is provided with OVERLORD SCHEDULER. The graphical representation to the user is a Gantt chart.



Methods

The illustrated configuration shows one example of a Spacelab implementation. This is a multifunctional system that is used for automation of compound library pre-loading processes. This system accommodates a full-size robotic liquid handling platform as well as a variety of peripherals including a dispenser, sealer, barcode labeler, barcode scanner, centrifuge and capper for microtubes. The entire system is enclosed in an environmentally controlled chamber.

1 Robotic Liquid Handler
2 Dispenser
3 Sealer
4 Capper
5 Centrifuge
6 Barcode Scanner
7 Barcode Labeler
8 Stack Carousels

This flexible system is used for two different processes: sample dissolution and plate reformatting/replication.

Sample Dissolution Automation:

1) The vials are placed in SBS footprint racks of 24.
2) Decapping is done for each vial with the liquid handler decapper on deck.
3) The robot provides destination labware from the carousel stacks.
4) The liquid handler accesses data file with bar code ID and dilution volume.
5) The liquid handler verifies each tube's ID then adds DMSO according to the specified dilution volume.
6) The liquid handler performs vortexing and sonication.
7) Automated camera system takes an image of each vial to verify complete dissolution.
8) From each dissolution vial aliquots of solution are transferred into REMP microvials using disposable tips.
9) An export file has to be created will the following information: Vial ID (barcode), rack ID (barcode), vial position (e.g. A01, B01, etc …)
10)Capping – all vials are capped after completion.

Creation of dissolution vials and master plates.

1) From each dissolution vial an aliquot is transferred into one to three 96-well plates containing microtubes.
2) From each dissolution vial a 32 ul aliquot is transferred into 11 384-well microplates.
3) Plate mapping is tracked and sent to customer database.
4) The robot moves the 384-well plates to be sparged with argon and heat-sealed using the sealer.
5) The robot moves the Remp plates to the Remp capper first for capping, then to carousel stacks.
6) Vials are sparged with argon and capped after completion.

Conclusion

The Spacelab offers a new concept of power and flexibility to address the evolving needs for laboratory automation. This system addresses the shortcomings of many dedicated automated systems by offering a solution that is space-conscious, flexible, reconfigurable, and compatible with any instruments of choice regardless of brand of manufacture.