Technical Report – Usability Upgrade for Camera Link® cameras

High speed interface modernized

Camera Link® was launched in 2000 as the first image processing standard and is currently the dominant interface for applications requiring very high resolutions and frame rates. For many years it was the only interface capable of meeting these requirements, hence its common use today. The latest standards such as GigE Vision® and USB3 Vision™ feature higher flexibility and easier integration, however. With the LX camera series, Baumer manages to transport flexibility and integration capabilities into Camera Link® making the interface more attractive and future-oriented in present-day applications.

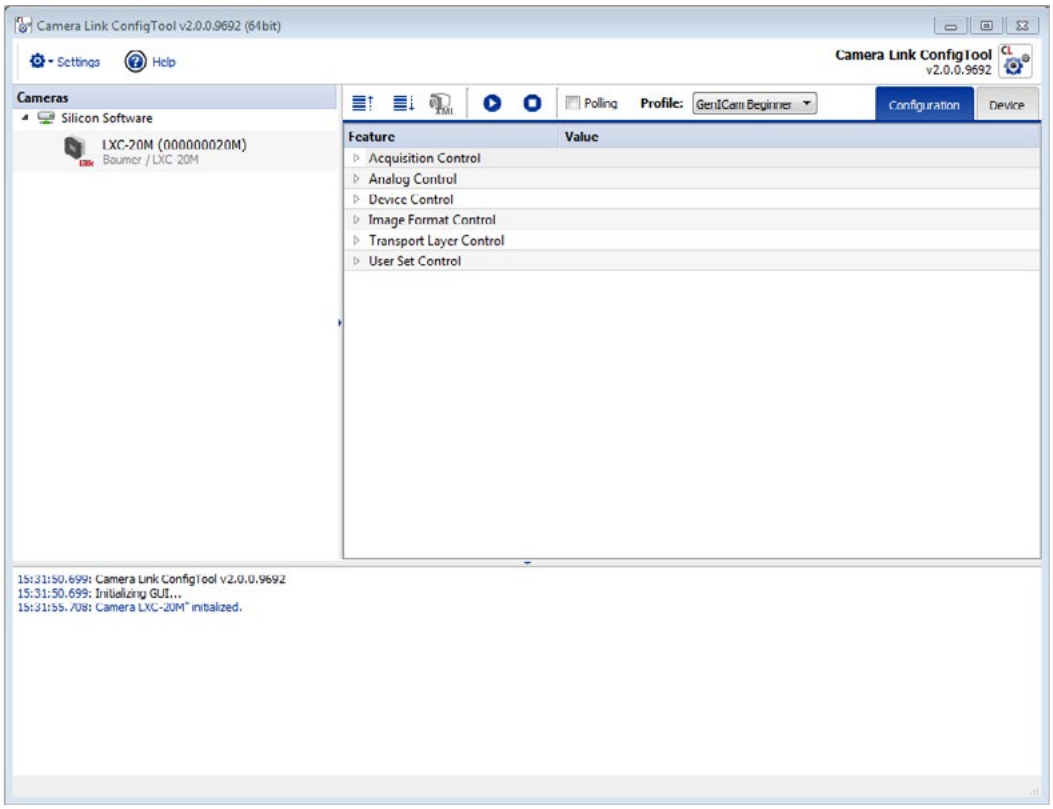
Camera Link® operates on a point-to-point connection between camera and PC and requires a frame grabber. This architecture enables very deterministic and reliable communication. Four variants (Base, Medium, Full and EightyBit) allow for at most 10 pixels to be transmitted with 8 bits at 85 MHz which allows for a high bandwidth of up to 850 MB/s – coupled with little complexity and very easy implementation. Unlike modern standards, however, it doesn't feature camera localization and parameterization – it merely defines an RS-232 communication interface. The protocol above is manufacturer-specific and requires direct programming of the camera registers, which is very time-consuming and error-prone, especially with complex functions. Extended status information is not available and integration requires tools and software development kits (SDK) from both the camera and the frame grabber manufacturer. Mandatory compatibility testing such as exists with GigE Vision® or USB3 Vision is not specified. As a consequence, implementation and support of Camera Link® are much more complex. The new LXC cameras by Baumer with extended functions considerably ease integration effort for the user.

LXC – easy to integrate by GenICam™

The current Camera Link® version 2.0 does not support a control protocol, the reason why GenICam™ provides extended Camera Link® functionality.



Baumer LXC cameras provide resolutions from 2 to 25 megapixel and up to 337 fps. This way, they capture the finest details even at high throughput and are ideal in demanding inspection tasks.

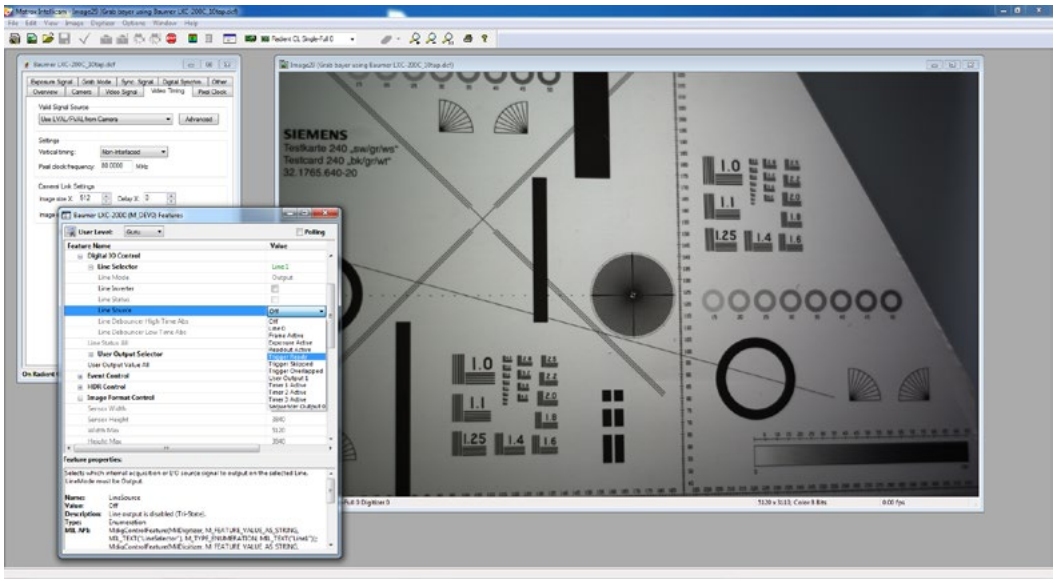


The Baumer Camera Link® ConfigTool is used for frame grabbers not supporting GenCP for quick and easy camera configuration.

The CLProtocol DLL (Dynamic Link Library) as core component for making the manufacturer-specific protocol compatible to GenICam™ is included in the camera manufacturer's software. Integrated in the frame grabber's SDK, it enables camera parameterization and image acquisition via a software environment. However, this approach is expensive because software components of several vendors' different operating systems need to be integrated and supported. To eliminate this drawback and additional effort, the GenCP (Generic Control Protocol) protocol was standardized as the new configuration protocol. Integrated in the new Camera Link® models of the LX series, Baumer ensures maximum user convenience in the implementation. Camera integration only requires specifying whether GenCP is supported by the frame grabber. If not, the entire camera configuration is made using a convenient configuration tool. Later integration into the customer's application is based on the GenICam™ reference implementation and realized by a specially developed SDK derivate with corresponding configuration examples. This protocol being increasingly in use helps more and more frame grabbers support GenCP. In this way camera configuration is easily realized directly via the frame grabber's SDK – without the need for any additional camera manufacturer software. To simplify integration even further, the Camera Link® clock in the LXC models can be selected between 40 MHz and 85 MHz providing the users with the benefit of either shorter latency or more flexibility by allowing longer cables at reduced frame rates. Furthermore, supporting the EightyBit mode enables very high frame rates or higher precision by 10 bits per pixel. Thanks to integrated optional PoCL (Power over Camera Link®), power is supplied directly via the frame grabber which will not only reduce cabling but also save integration and maintenance costs.

Quick error detection and verification of system stability

Unlike GigE Vision®, Camera Link® provides only limited diagnostic capabilities. To Baumer this was the reason for putting intelligent functionalities center stage in the LXC cameras. For the first time, camera events and status information such as trigger or sensor exposure status is made available for immediate error analysis during implementation and for monitoring proper triggers in running operation. Camera Link® provides no control



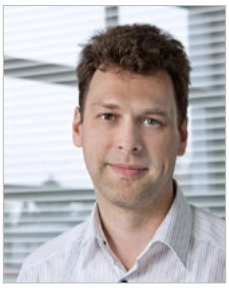
Frame grabbers supporting GenCP enable camera configuration directly in the manufacturer's SDK. As GenCP becomes more and more established this approach will continue to gain market acceptance.

mechanisms for error detection and troubleshooting in data transmission, which is important when the camera is operating at high pixel clocks, in long cable sections or when applied in robotics. For this reason, the LXC cameras use a checksum in image data, similar to the GigE Vision® standard. This way, users can check data integrity in the software without having to perform any change in the frame grabber configuration – even in running operation to eliminate evaluation errors. Cables up to 15 meters in length proved successful in tests. Furthermore, Camera Link® cameras provide additional Meta data to verify system stability. Using the FrameID, proper transmission of each image is monitored by help of the image sequence number. The RegionID eases framing assignment at Multi-ROI applications whereas a time stamp ensures synchronous image acquisition by multiple cameras.

Camera Link® aligned towards the future

Due to high bandwidth and having been established for many years, Camera Link® still holds a significant presence on the market. Today as in the past many new component designs are pulled towards this interface. By using the GenCP protocol camera integration is simplified significantly and integration effort is reduced. In addition, it provides enhanced capabilities for monitoring camera status and for verifying data integrity. Hence, the Baumer LXC cameras with GenCP protocol ensure high reliability in the image processing system. Thanks to resolutions from 2 to 25 megapixel and up to 337 fps, the cameras capture even finest details in inspection tasks at high throughput. Integrating the latest global shutter CMOS sensors, they provide excellent image quality at extremely high sensitivity. This way, the LXC cameras are ideal for demanding applications in the manufacture of semiconductors and electronics, in metrology, lab automation and traffic inspection.

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